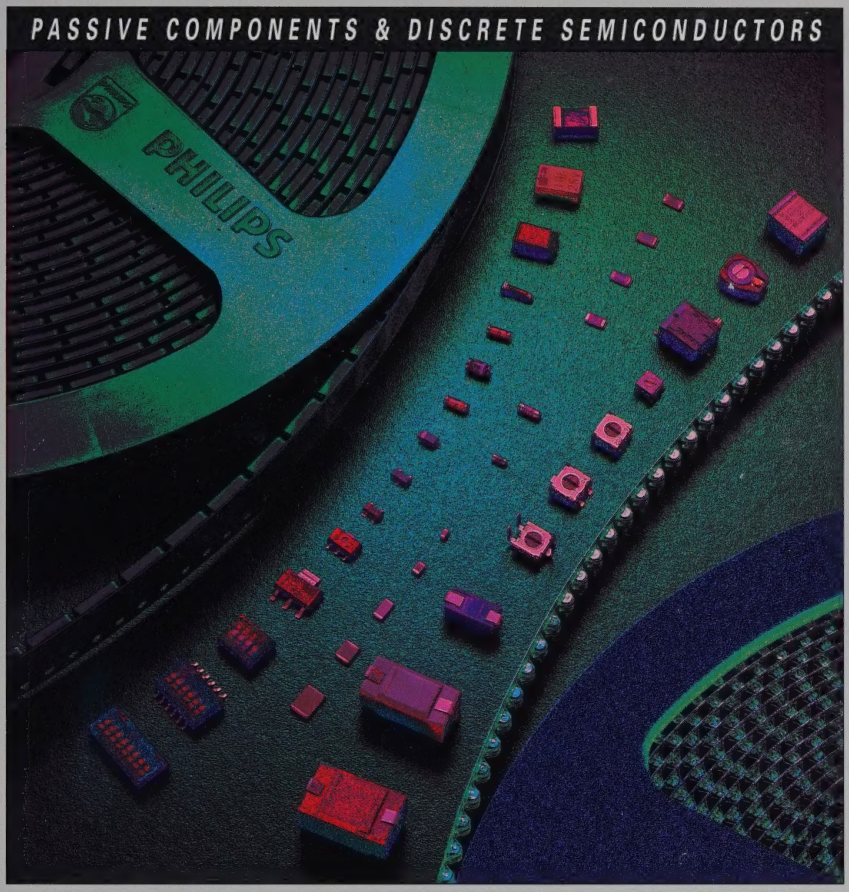

Surface Mount Device Catalog 92/93

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☐ Leaded Resistors/Capacitors (PC002-2)
☐ Discrete Semiconductors (PC040-3)
☐ Linear Ferrite Materials/Components (PC052-1)

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A Leader in Electronic Components

Philips Components Discrete Products Division (Philips Components), a world leader in electronic components, is a North American Philips Company. North American Philips Corporation is a wholly-owned subsidiary of Philips Electronics N.V., of the Netherlands. Philips Components offers a broad line of quality electronic products to include resistors, capacitors, discrete semiconductors, professional components and magnetic products. Our products serve major end markets to include computer, telecommunications, automotive, industrial, and military/government.

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The Philips Components team is committed to providing our customers with a broad line of best-in-class electronic components, coupled with unsurpassed quality and service, on-time delivery, and competitive pricing. We recognize that this commitment is absolutely necessary for us to remain a leader in the industry, both now and in the future. To better assist our customers, Philips Components maintains an extensive sales network comprised of national account teams, direct sales engineers, field applications engineers, manufacturer's representatives and distributors ready to serve you.

How to Use this Catalog

This catalog contains descriptive product and technical data on surface mount device products and has been designed for your quick, easy reference. Please review the following tips.

1. The *Table of Contents* provides a complete listing of all product sections and series.
2. The *Index of Sections,* complete with tabs, allows you to quickly locate sections 1 through 11.
3. Once you have turned to a particular section of interest, simply refer to the *quick reference header* at the top corner of each page to locate the correct product information. Each new section and series will include a product photo for easy identification.

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To receive additional Philips Components catalogs, handbooks, brochures or data sheets on surface mount devices or other Philips Components products, please complete and mail one of the enclosed postage-paid business reply cards to:

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To receive pricing, availability and distributor information, please call the Philips Components sales organization in your area. A complete listing of our sales offices and phone numbers is available on the back cover of this catalog.

Thank you for your interest in Philips Components. We're determined to be your best supplier!

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Monolithic SMD® Chip Capacitors

Tantalum SMD® Chip Capacitors

Aluminum Electrolytic SMD® Chip Capacitors

Metallized Polyphenylene Sulphide Film Capacitors

SMD® Trimmer Capacitors

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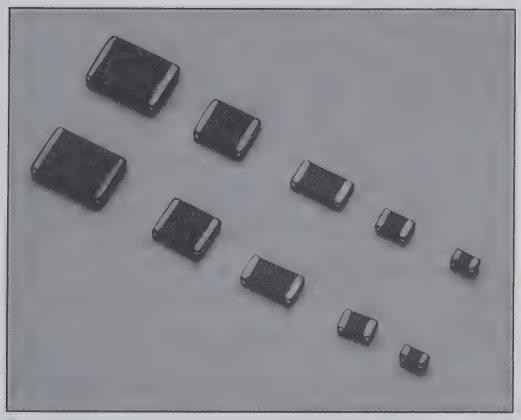
Precision MELF SMD® Resistors

SMD® Thermistors

SMD® Trimming Potentiometers

SMD® Switches

SMD® Transistors & Diodes



Monolithic SMD® Chip Capacitors, Series C

Description

The monolithic ceramic chip design provides state-of-the-art volumetric efficiency in a capacitance device. Constructed from screening metal electrode material onto ceramic dielectric material with an inherent high K, alternating stacked layers are fired at a high temperature yielding a monolithic unit. Conductive metal alloy end terminations connect the alternating electrode layers to achieve a paralleling of the interleaved electrode plates and provide the means for electrical and mechanical contact within the circuit. Through this design of construction, the geometric factor is maximized by providing a large electrode area within a small housing unit.

Philips Components offers three types of dielectric material. NPO (COG)—CLASS I—is an ultrastable dielectric recognized by a zero TC slope. These capacitors satisfy applications in which a specific capacitance value and a high Q (low dissipation factor) is critical for proper circuit performance. X7R and Z5U—CLASS II and III respectively are commonly referred to as stable and general purpose dielectrics, respectively. These capacitors exhibit a predictable change in capacitance over a specified operating temperature range. They are typically used in circuits for bypassing and decoupling applications.

In choosing the termination material, consideration should be given to the assembly process. Philips Components offers several termination options.

Features

- Superior volumetric efficiency
- Adaptable to high speed automated mechanization assembly
- Excellent printed circuit board density as well as utilization of both board sides
- Capacitance range from 0.47 picofarad to 0.68 microfarad
- Voltage range from 50 to 100 volts
- Three standard dielectric material systems: NPO, X7R & Z5U
- Three standard terminations: Nickel Barrier, Tin/Lead; Nickel Barrier, 100% Tin; Palladium-Silver
- Components manufactured in a clean room environment using statistical and machine process control measures

Part Number Designation

Ordering codes (14-digit alphanumeric code)

XXXX	XX	XX	X	X	X	X	X	X
Size	Material	Cap	Multiplier	Tolerance	Voltage	Termination	Packaging	Marking
0603	NPO CG	10	x 0.01 8	±0.25pF C	50 9	Ag/Pd A	bulk A	no mark 0
0805	X7R 2R	12	x 0.1 9	±0.5pF D	100 0	Ni/Sn B	7″ T&R B	1 character 1
1206	Y5V* 2F	15	x1 0	±5% J		Ni/Sn-Pb C	13″ T&R D	2 character 2
1210	Z5U 2E	18	x10 1	±10% K				Mfg. ID 5
1812		22	x100 2	±20% M				
		27	x1000 3	+80/-20% Z				
		33	x10000 4					
		39						
		47						
		56						
		68						
		82						

Example:

- To order 0.1μF ±10%, X7R dielectric, 50 volt, 1206 size with Ni/Sn termination, tape and reel: 12062R104K9BB0
- To order 33pF ±5%, NPO dielectric, 100 volt, 0805 size with Ni/Sn-Pb termination, tape & reel: 0805CG330J0CB0

* Contact factory for availability

Marking notes:

- Marking per EIA
- Marking not available on size 0603
- 1 character marking available on size 0805 and larger
- 2 character marking available on size 1206 and larger

Marking

An option of three marking systems is available to accommodate specific customer requirements.

- SINGLE CHARACTER ALPHANUMERIC COLOR CODE. The character designates two significant digits of capacitance, the color designates the multiplier of capacitance in picofarads. Standard for 0805 size.
- TWO CHARACTER CODE. The alpha identifier designates two significant digits of capacitance, the numeric identifier designates the multiplier of capacitance in picofarads. Standard for 1206 or larger sizes.
- MFG. ID CODE. The Mfg. ID code designates the Philips Components Logo for SMD Product. Fig. 1

"Two Character Marking"

Significant Figure	Alpha Identifier	Significant Figure	Alpha Identifier
1.0	A	4.7	S
1.1	B	5.1	T
1.2	C	5.6	U
1.3	D	6.2	V
1.5	E	6.8	W
1.6	F	7.5	X
1.8	G	8.2	Y
2.0	H	9.1	Z
2.2	J	2.5	a
2.4	K	3.5	b
2.7	L	4.0	d
3.0	M	4.5	e
3.3	N	5.0	m
3.6	P	6.0	n
3.9	Q	8.0	t
4.3	R	9.0	y

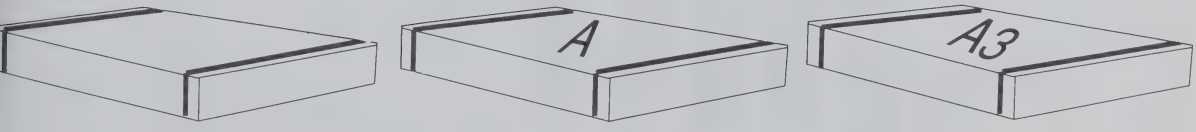
Numeric Character	Decimal Multiplier	Numeric Character	Decimal Multiplier
0	10^0	5	10^5
1	10^1	6	10^6
2	10^2	7	10^7
3	10^3	8	10^8
4	10^4	9	10^{-1}

"Single Character Marking"

Significant Figure	Alpha Identifier
10	A
11	B
12	C
13	D
15	E
16	H
18	I
20	J
22	K
24	L
27	N
30	O
33	R
36	S
39	T
43	V
47	W
51	X
56	Y
62	Z
68	3
75	4
82	7
91	9

Color	Multiplier
ORANGE	10^{-1}
BLACK	10^0
GREEN	10^1
BLUE	10^2
VIOLET	10^3
RED	10^4

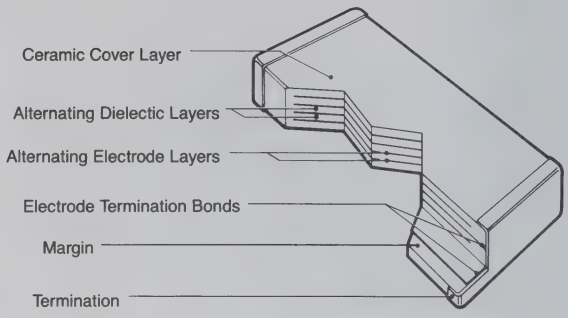
Fig. 1



Construction and Characteristics

Monolithic Construction

Monolithic ceramic capacitors consist of alternating ceramic (15 to 30 microns) onto which metal electrodes are printed. The stacked layers, cut into individual chips, are then sintered at a very high temperature to form a monolithic device. Alternating electrode layers are connected to end terminations completing the functional unit.

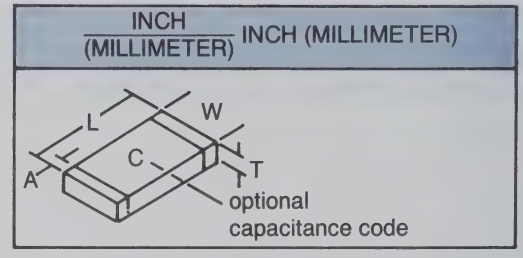


General Specifications

Electrical Parameters

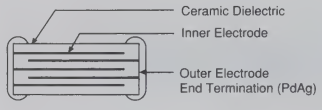
Capacitance Range: 0.47 pF through 0.68μF
Capacitance Tolerance: (Standard)
NPO: C ± 0.25pF D ± 0.5pF
J ± 5% K ± 10%
For values < 10pF, tightest tolerances available are C & D
X7R: J = ±5%
K = ±10%
M = ±20%
Z5U: M = ±20%
Z = +80 − 20%
P = GMV (Guaranteed Minimum Value)
Other tolerances available, contact factory
Working Voltage: 50, 100, VDC
Temperature Characteristics:
NPO: 0 ± 30 ppm/°C, −55°C to +125°C
X7R: ±15% ΔC, −55° to +125°C
Z5U: +22% to −56% ΔC, +10°C to +85°C
Capacitance test @ 25°C or referenced to 25°C:
NPO: 1.0 VRMS ±.25 VRMS @ 1kHz for values above 1000pF, 1 MHz for 1000pF and lower values.
X7R: 1.0 VRMS ±.25 VRMS @ 1kHz.
Z5U: 0.5 VRMS ±0.1 VRMS @ 1kHz.
Dissipation Factor:
NPO: 0.1% maximum @ 25°C, 1.0 VRMS ±.25 VRMS @ 1kHz., 1 MHz for 1000pF and lower values down to 50 pF D.F. for 5pF ≤ C < 50 pF $= 1.5 \times \left[\frac{150}{C} + 7\right] \times 10^{-4}$
D.F. for C < 5 pF = 0.30%
X7R: 2.5% maximum @ 25°C, 1.0 VRMS ± .25 VRMS @ 1kHz.
Z5U: 4.0% maximum @ 25°C, 0.5 VRMS ± 0.1 VRMS @ 1kHz.
Insulation Resistance:
100K megohms or 1000 megohm microfarads, whichever is less at 25°C. Measured after 2 min. with 50 mA limiting current.
Dielectric Strength:
NPO, X7R, Z5U: 250% rated voltage with 50 mA maximum charging current.

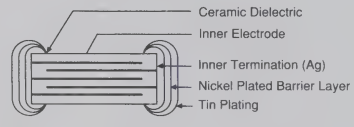
Mechanical Parameter

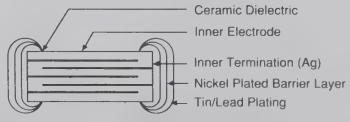


Terminations Available

Palladium—Silver
Nickel Barrier, 100% Tin
Nickel Barrier, Tin/Lead







Class 1 Capacitors: NPO Dielectric

Capacitance Range 1)	0.47pF to 5600pF
Tolerance 1)	±0.25pF, ±0.5pF for values < 10Pf
	±5%, ±10%
Rated D.C. Voltage	50v, 100v
tan δ 1)	
C < 5pF	≤ 30 × 10(−4)
5pF ≤ C < 50pF	≤ 1.5 × (150/C+7) × 10(−4), max 30 × 10(−4)
C ≥ 50pF	≤ 10 × 10(−4)
Insulation Resistance	100GΩ

1) measured @ 1MHz, 1.0v for C ≤ 1000pF, and @ 1kHz, 1.0v for C > 1000pF.
Temperature Coefficient: C < 10pF: (0 ± 150) × 10(−6)/K for 0805 and 1206
C ≥ 10pF: (0 ± 30) × 10(−6)/K for other sizes

Selection Chart

Size		0503		0805		1206		1210		1812	
	WVDC	50	100*	50	100	50	100	50	100	50	100*
Coded Cap	478										
	109										
	129										
	159										
	189										
	229										
	279										
	339										
	399										
	479										
	569										
	689										
	829										
	100										
	120										
	150										
	180										
	220										
	270										
	330										
	390										
	470										
	560										
	680										
	820										
	101										
	121										
	151										
	181										
	221										
	271										
	331										
	391										
	471										
	561										
	681										
	821										
	102										
	122										
	152										
	182										
	222										
	272										
	332										
	392										
	472										
	562										

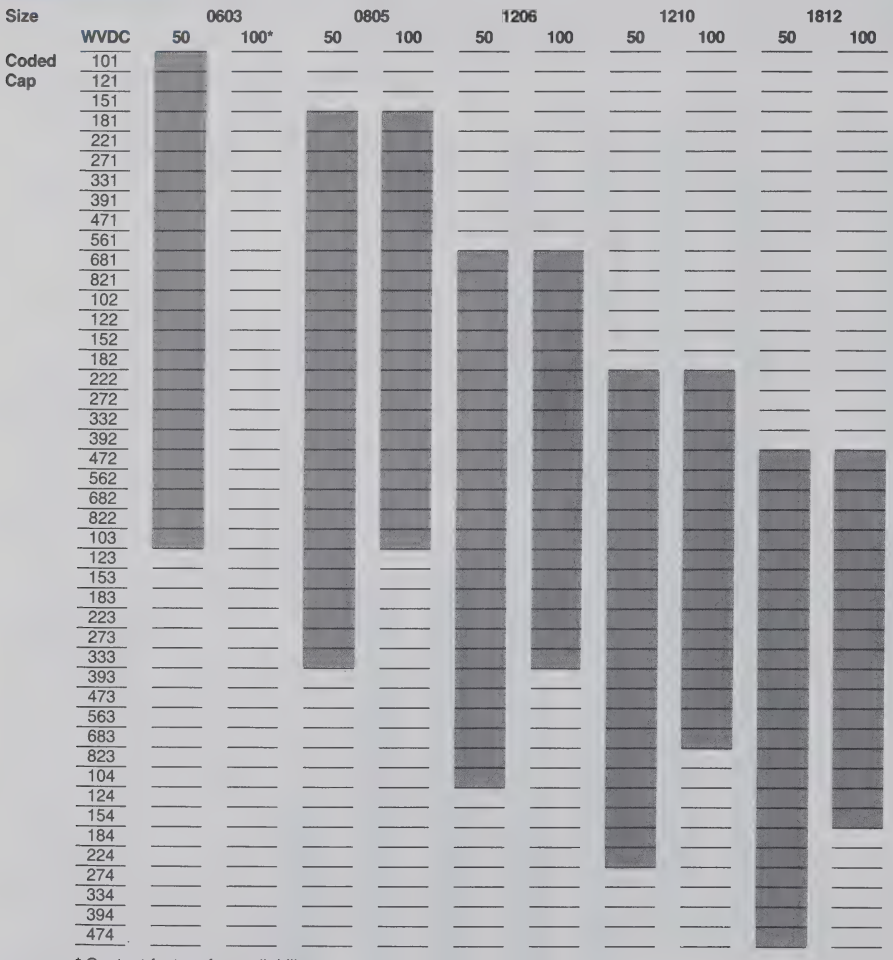
*Contact factory for availability

Class 2 Capacitors: X7R Dielectric

Capacitance Range 1)	100pF to 0.47μF
Tolerance	±5%, ±10%, ±20%
Rated D.C. Voltage	50v, 100v
tan δ 1)	≤2.5%
Insulation Resistance	100K megohms or 1000 megohm microfarads, whichever is less at 25°C. Measured after 2 min. with a 50mA limiting current.

1) measured @ 1KHz, 1.0v

Selection Chart



* Contact factory for availability

Class 3 Capacitors: Z5U Dielectric

Capacitance Range 1)	1000pF to 0.68μF
Tolerance	$\pm$20%, +80/−20% $\pm$5%, $\pm$10%
Rated D.C. Voltage	50v
tan δ 1)	$\leq$ 4.0%
Insulation Resistance	100K megohms or 1000 megohm microfarads, whichever is less at 25°C. Measured after 2 min. with a 500mA limiting current.

1) measured @ 1KHz, 0.5v.

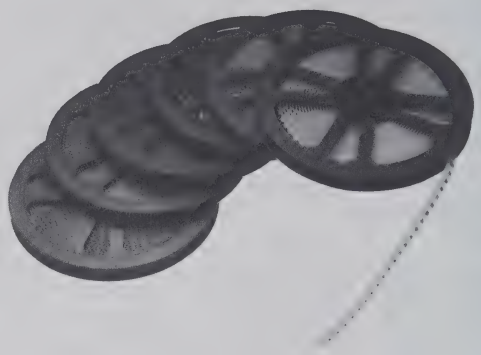
Selection Chart

Size		0805	1206	1210	1812
	WVDC	50	50	50	50
Coded Cap	102				
	122				
	152				
	182				
	222				
	272				
	332				
	392				
	472				
	562				
	682				
	822				
	103				
	123				
	153				
	183				
	223				
	273				
	333				
	393				
	473				
	563				
	683				
	823				
	104				
	124				
	154				
	184				
	224				
	274				
	334				
	394				
	474				
	564				
	684				

Chip Capacitor Packaging

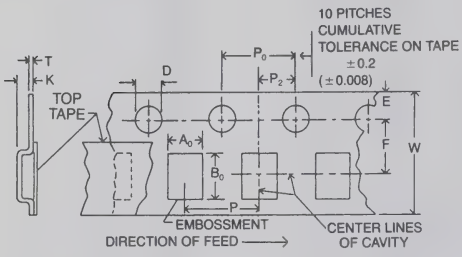
Bulk

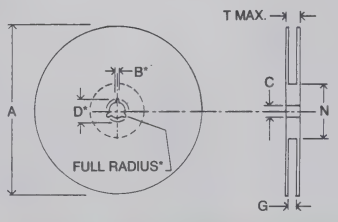
Philips Components standard bulk packaging is with a heat-sealed plastic bag. Quantities per container range from 500 to 10,000 pieces depending on chip size. A tarnish inhibitor is included in each container to protect terminations.



Tape and Reel

Specifically designed for high speed production, Philips Components offers a variety of chip sizes in a tape and reel package per EIA RS481 specifications. Embossed carrier tape is produced in 8mm and 12mm widths specifically for Philips Components chip capacitors. Both are available on 7 inch (3,000 to 4,000 pieces) or labor-saving 13 inch reels (10,000 pieces).





Embossed Carrier Dimensions $\frac{\text{in}}{(\text{mm})}$

Tape Size	W	F	E	Po	Pz	D	Tmax	Kmax	P	Ao, Bo
8 mm	.315 ± .008 (8.0 ± 0.2)	.138 ± .002 (3.5 ± 0.5)	.069 ± .002 (1.75 ± .05)	.157 ± .004 (4.0 ± 0.1)	.079 ± .002 (2.0 ± .05)	$.059^{+.0004}_{-.0000}$ $(1.5^{+0.1}_{-0.0})$	.012 (0.3)	.079 (2.0)	.157 ± .004 (4.0 ± 0.1)	*
12 mm	.472 ± .008 (12 ± 0.2)	.217 ± .002 (5.5 ± 0.5)	.069 ± .002 (1.75 ± .05)	.157 ± .004 (4.0 ± 0.1)	.079 ± .002 (2.0 ± .05)	$.059^{+.0004}_{-.0000}$ $(1.5^{+0.1}_{-0.0})$	.012 (0.3)	.177 (4.5)	.315 ± .004 (8.0 ± 0.1)	*

*Ao, Bo are determined by component size

Reel Dimensions $\frac{\text{in}}{(\text{mm})}$

Tape Size	Bmin	C	A 7 inch	A 13 inch	Dmin	Nmin	G	Tmax
8 mm	.079 (2.0)	.512 ± .02 (13 ± .05)	7 ± .079 (178 ± 2.0)	13 ± .008 (330 ± 0.2)	.795 (20.2)	1.97 (50)	.394 ± .059 (10 ± 1.5)	.587 (14.9)
12 mm	.079 (2.0)	.512 ± .02 (13 ± .05)	7 ± .079 (178 ± 2.0)	13 ± .008 (330 ± 0.2)	.795 (20.2)	1.97 (50)	.394 ± .059 (10 ± 1.5)	.587 (14.9)

Quantity per Reel Information

Chip Size	Carrier Width	Voltage	Dielectric	Cap Range	Qty/reel 7 Inch	Qty/reel 13 Inch
0603	8mm	50	NPO	479 to 151	4,000	10,000
		50	X7R	101 to 103	4,000	10,000
0805	8mm	50	NPO	479 to 331	4,000	10,000
		50	NPO	391 to 821	3,000	10,000
		100	NPO	479 to 331	4,000	10,000
		100	NPO	391 to 821	3,000	10,000
		50	X7R	181 to 153	4,000	10,000
		50	X7R	183 to 333	3,000	10,000
		100	X7R	181 to 103	4,000	10,000
		50	Z5U	102 to 473	4,000	10,000
		50	Z5U	563 to 104	4,000	10,000
1206	8mm	50	NPO	479 to 102	4,000	10,000
		50	NPO	122 to 332	3,000	10,000
		100	NPO	479 to 102	4,000	10,000
		100	NPO	122 to 332	3,000	10,000
		50	X7R	561 to 104	4,000	10,000
		100	X7R	561 to 333	4,000	10,000
		50	Z5U	103 to 104	4,000	10,000
		50	Z5U	124 to 184	3,000	10,000
1210	8mm	50	NPO	829 to 472	3,000	10,000
		100	NPO	471 to 472	3,000	10,000
		50	X7R	182 to 224	3,000	10,000
		100	X7R	182 to 683	3,000	10,000
		50	Z5U	103 to 224	4,000	10,000
		50	Z5U	274 to 334	3,000	10,000
1812	12mm	50	NPO	331 to 332	1,500	6,000
		50	NPO	392 to 562	1,000	4,500
		50	X7R	392 to 334	1,500	6,000
		50	X7R	394 to 474	1,000	4,500
		100	X7R	392 to 104	1,500	6,000
		100	X7R	124 to 154	1,000	4,500
		50	Z5U	103 to 684	1,000	4,500

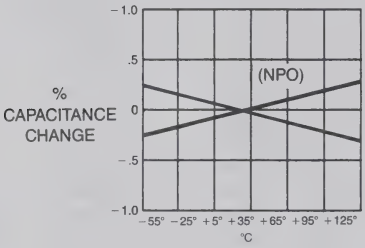
Dielectric Characteristics

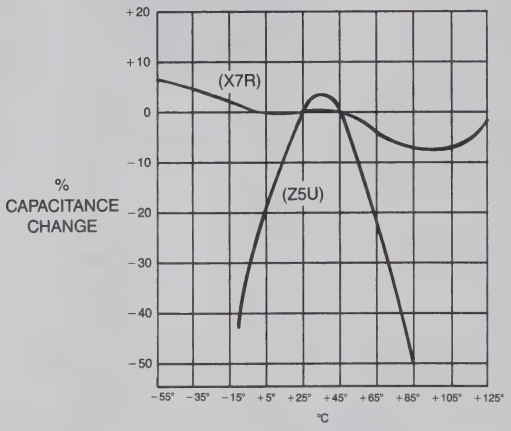
Temperature Characteristics

The temperature co-efficient is defined as the change in capacitance over a specified temperature range and is measured at zero bias, with the amount of change relative to 25°C conditions. The electrical stability of a component, defined by temperature and voltage characteristics, is related to its dielectric constant.

NPO—a Class I dielectric—possesses a zero temperature co-efficient, allowing superior stability. The TC of a NPO component is expressed in PPM/°C. Class II dielectrics—X7R, Z5U—are ferroelectric ceramics and while the dielectric constant of these materials are superior to Class I, the electrical stability is nonlinear with the TC being expressed as % change in capacitance across a specified temperature range.

Capacitance Change vs. Temperature

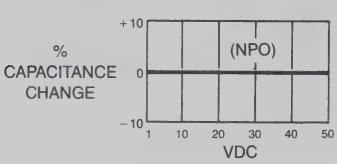


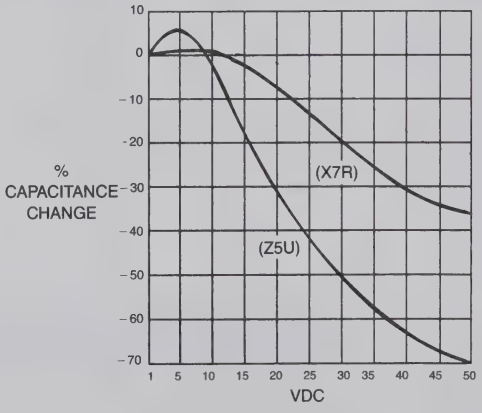


Voltage

Class I dielectrics are not significantly affected by increases in voltage; however, Class II ferroelectric dielectrics display a decrease in the dielectric constant as the DC bias increases. With increases in DC voltage the polarization cycle which acts to oppose DC bias is inhibited. Thus, a high K dielectric exhibits a reduced dielectric co-efficient when subject to strong DC electric fields.

Capacitance Change vs. DC Voltage





Dissipation Factor (DF)

The dissipation factor is the ratio of resistance to reactance used as a measure of dielectric loss resulting from continual reversing of the polarity of the electric field. These "relaxation losses" occur when the molecular structure must adjust to a new polarity and are manifested through heat dissipation and a measurable deviance from the 90° current—voltage phase angle. The DF is frequency sensitive and is expressed as a percentage.

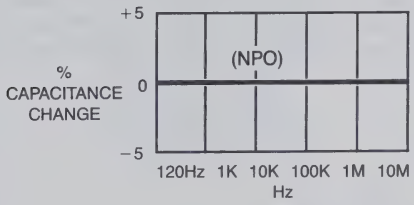
Quality Factor (Q)

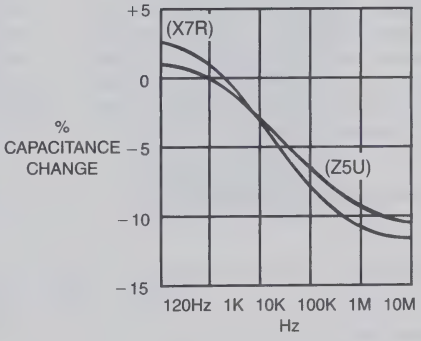
The Quality Factor is the inverse of the loss factor (DF)—the ratio of reactance to resistance. Quality Factor is also frequency dependent.

Insulation Resistance

All capacitors have a small amount of leakage current. Insulation resistance, usually measured in megohms is the capacitor's ability to block this current.

Capacitance Change vs. Frequency





Application Notes

Pad Design

Successful ceramic chip attachment to a circuit board/substrate is relative to specific mechanical considerations. Because the thermal co-efficient of expansion of the ceramic dielectric differs from that of epoxy glass circuit board and alumina substrate, the pad design and soldering process must compromise the effects of sharp temperature gradients imposed on the assembled units. Recommendations for pad design are based on two soldering processes—Reflow and Wave. Reflow soldering employs solder paste coated pads; whereas, Wave relies on glue attachment of the chip to the board.

REFLOW METHOD. Using this process, the dimensions are determined by chip size, placement accuracy and the amount of solder for an acceptable fillet. Dried solder paste coats the pad and holds the chip in place. Chip to board attachment is achieved by remelting and reflowing the solder. Alignment of the chip during reflow is accommodated by the pad design as the chip tends to move in response to surface tension forces generated by the molten solder wetting the termination metalization. The reflow process should begin with a gradual heating of the board and components to the solder melting temperature (approximately 2°C/sec.), followed by continued heating to 30° above that temperature for 10 to 20 seconds. The assembly may then cool slowly in ambient temperature (25°C).

WAVE METHOD. This process involves glue attachment of the component to the board. After preheating the assembly to within 100°C of the solder temperature, (typically 220° to 250°C), the board is immersed in a wave of molten solder for 3 to 5 seconds. The solder fillet size must be contained so that the solder bond strength does not overcome the chips inherent strength. This can be achieved by limiting the pad size so that it does not extend beyond the chips terminations. A hot air-knife following the solder wave may also reduce fillet size.

TOMBSTONE or *DRAWBRIDGING* results when both terminations are not wetted equally or at the same time. When one termination wets first the resulting surface tension acts to lift the opposing termination while the molten solder at the non-wetted termination contributes to this action by allowing the end to float. In the second instance, a chip misplaced lengthwise on the pads, with one termination close to or over the edge of its pad, even with both terminations equally wetted, with no fillet to hold the opposing end down, that end will lift.

Test Conditions in Static Solder Bath

Solderability

95% covered with smooth and bright solder coating

CECC: 235 ± 5°C for 2 ± 0.5 s
IEC: 215 ± 3°C for 3 ± 0.3 s
EIA: 260 ± 5°C for 30 ± 1 s

Resistance to soldering heat

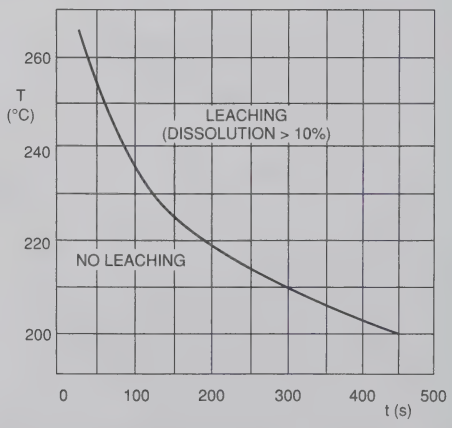
10% of the metallization of the edges of the head face may be missing (linear electrodes not visible)

$\frac{\Delta C}{C}$ class 1; 0.5% or 0.5 pF

and

$\frac{\Delta C}{C}$ class 2; $\begin{matrix} -5\% < \text{X7R} \leq 10\% \\ -10\% < \text{Z5U} \leq 20\% \end{matrix}$

must not be exceeded

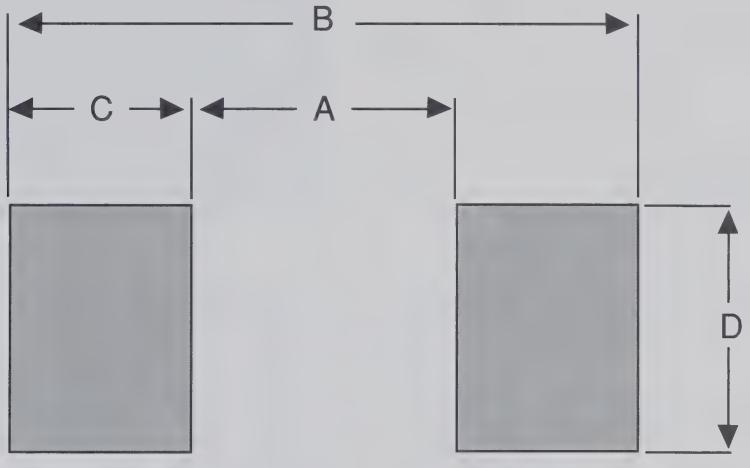


Resistance to leaching of AgPd metallized terminations (in static solder bath) at various temperatures; for NiSn metallized terminations, the leaching resistance is a factor of 10 times better than shown in the graph.

Methods of Mounting and Dimensions of Solderlands

For normal use the capacitors may be mounted on printed-circuit boards or ceramic substrates by applying wave soldering, reflow soldering (including vapour phase soldering) or conductive adhesive (for advised soldering profiles, see figures 21, 22 and 23).

An improper combination of soldering conditions, substrate and chipsize can lead to a damaging of the component. The risk increases with chipsize and with temperature fluctuations ($>$ 100°C). Therefore it is advised to use the smallest possible size and follow the recommendations given in the table below, (all dimensions are in mm).



Recommended dimensions of solderlands.

Reflow soldering

Size	A	B	C	D
0603	0.9	2.3	0.7	0.8
0805	0.8	3.4	1.3	1.4
1206	1.8	4.0	1.1	1.7
1210	1.8	4.6	1.4	2.6
1812	2.8	6.2	1.7	3.3

Wave soldering

Size	A	B	C	D
0603	0.9	2.5	0.8	0.8
0805	1.2	3.6	1.2	1.2
1206	2.0	4.8	1.4	1.4
1210	2.0	4.8	1.4	2.5
*1812	3.0	6.2	1.6	3.2

*Size 1812, is recommended to be mounted on ceramic substrate and reflow soldered only.

Fig. 21 Reflow soldering.

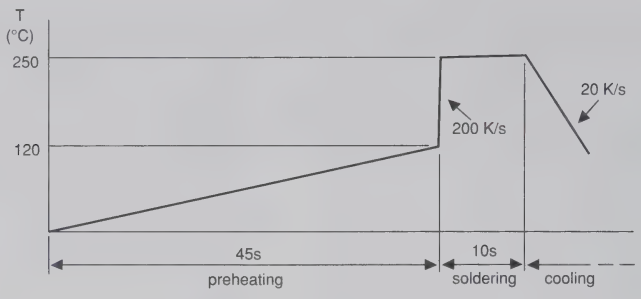


Fig. 22 Wave soldering. The capacitors may be soldered twice in accordance with this method if desired.

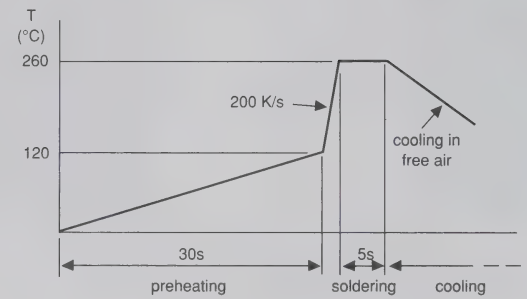
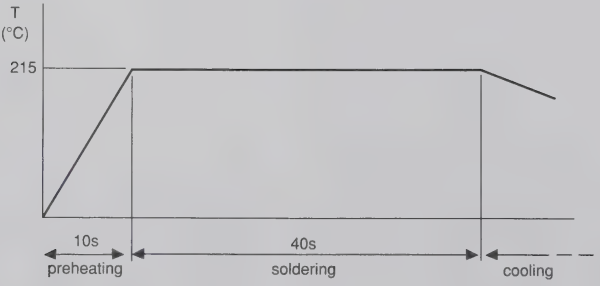
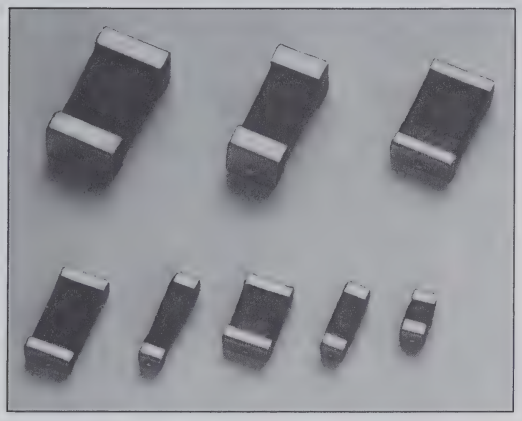


Fig. 23 Vapour phase soldering.





BLUE CHIP Tantalum SMD® (Chip) Capacitors Series 49BC

Description

The 49BC BLUE CHIP Series is the original conformally coated Chip Tantalum Capacitor developed and patented in the early 1970's.

Electronic applications had evolved tighter and tighter requirements which demanded more reliable components with longer life, lower electrical losses and more volumetric efficiency due to the constraints of smaller and smaller circuitry.

The BLUE CHIP capacitor was developed to fill those needs. It combined the long life and high reliability of a tantalum capacitor with the desirable design elements of a chip component. Low ESR, low DC leakage, low inductance and maximum volumetric efficiency are hallmarks of the BLUE CHIP capacitor's design and construction.

The BLUE CHIP utilizes a high CV, sintered tantalum anode and a solid electrolyte to achieve its small size. It is conformally coated with the patented Blue Seal process. The fluoropolymer/fluoroelastomer coating provides protection to the internal capacitive element while remaining flexible enough to withstand thermal stresses and adding a minimum to the overall size of the capacitor. Ruggedized terminal construction provides a margin of reliability not found in other styles.

The BLUE CHIP has become the unquestioned industry standard of reliability in circuit assembly and performance. The product has been customer tested and proven—over 400 million unit user test hours—in a broad range of circuit applications under severe environmental and electrical stress conditions. The CWR06 style BLUE CHIP is available in both military established reliability—Exponential Failure Rate Levels (M, P, and R) and Weibull Graded Failure Rate Levels (B, C, and D), per MIL-C55365/4.

Philips Components manufactures the BLUE CHIP products utilizing advanced Statistical Process Control methods (SPC). The use of Statistical Process Control techniques provides a very consistent and reliable product.

Features

- −55°C through 85°C Operation (125°C with Voltage Derating)
- Capacitance Range: 0.1 μF to 100 μF
- Rated Voltages: 4 VDC to 50 VDC
- Qualification to MIL-C-55365/4 Style CWR06 Exponential Failure Rate Levels M, P, and R and Weibull Graded Failure Rate Levels B, C, and D
- 8 Case Sizes from .050″ × .050″ × .100″ To .110″ × .150″ × .285″
- Low ESR in High-Frequency Applications
- Gold Plated or Solder Dipped Terminations
- Conformally Coated Construction Provides Maximum Volumetric Efficiency (100,000 μFV/Cubic Inch)
- Tape & Reel Packaging Available in 8 & 12 mm Tape Widths

®SMD is a Service Mark of North American Philips Corporation
®BLUE CHIP is a Registered Trade Mark. The BLUE CHIP is patented under US Patent No. 3,855,505

Part Number Designation

49 BC 105 B 004 K 0 A D FB

- 49 — SMD Chip Tantalum Capacitor
- BC — BLUE CHIP Series
- 105 — Capacitance in Picofarad Code*
- B — Case Code
- 004 — DC Voltage Rating
- K — Capacitance Tolerance
- 0 — Unsleeved
- A — Grade/Reliability Level
- D — Termination Finish
- FB — Packaging

First two digits are significant figures, Third digit is number of zeros to follow.

Capacitance Tolerance:
J = ± 5%
K = ± 10%
M = ± 20%

Grade/Reliability Level:
A = Industrial Grade
B = CWR06 Weibull 'B' Grade
C = CWR06 Weibull 'C' Grade
D = CWR06 Weibull 'D' Grade
M = CWR06 'M' Level
P = CWR06 'P' Level
R = CWR06 'R' Level
X = Requires PC Internal Spec such as CS3000 or any Customer Special Order

Termination Finish:
D = Hot 60/40 Solder Dipped
G = Gold Plated

Packaging:
FB = "Blister Pack" 50 unit Trays
FT = Tape & Reel (EIA RS-481A)

The BLUE CHIP Part Number
—Start P/N with 49BC—
then obtain Capacitance Code,* Case Code and Voltage Rating from the CV table below, add Tolerance, Level, Termination and Packaging from lists above.

49BC Capacitance—Voltage—Case Code Table

Select standard Capacitance/Voltage ratings and corresponding standard BLUE CHIP case codes from this table. If you require a capacitance/voltage that is not listed as a standard value, please call us. We may already be building it as a special.

Cap µF	Picofarad Code*	004 V	006 V	010 V	015 V	020 V	025 V	035 V	050 V
0.10	104	B	B	B	B	B	B	B	B
0.15	154	B	B	B	B	B	B	B	B
0.22	224	B	B	B	B	B	B	B	L
0.33	334	B	B	B	B	B	B	L	L
0.47	474	B	B	B	B	B	L	L	U
0.68	684	B	B	B	B	L	L	U	E
1.0	105	B	B	B	L	L	U	E	C
1.5	155	B	B	L	L	U	E	C	H
2.2	225	B	L	L	U	E	C	H	H
3.3	335	L	L	U	E	C	H	H	I
4.7	475	L	U	E	C	H	H	I	P
6.8	685	U	E	C	H	H	I	P	—
10.0	106	E	C	H	H	I	I	—	—
15.0	156	C	H	H	I	I	P	—	—
22.0	226	H	H	I	I	P	—	—	—
33.0	336	H	I	I	P	—	—	—	—
47.0	476	I	I	P	—	—	—	—	—
68.0	686	I	P	—	—	—	—	—	—
100.0	107	P	—	—	—	—	—	—	—

Physical Specifications

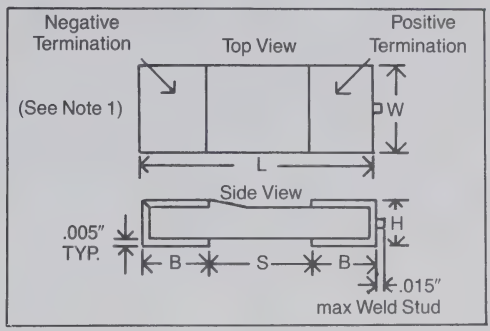
Dimensions—Inches

Case Code		(W) Width ±0.015	(L) Length ±0.015	(H) Height ±0.015	(S) Spacing Typical	(B) Pad Width ±0.005
49BC	CWR06					
B	A	.050	.100	.050	.040	.030
L	B	.050	.150	.050	.090	.030
U	C	.050	.200	.050	.140	.030
E	D	.100	.150	.050	.090	.030
C	E	.100	.200	.050	.140	.030
H	F	.135	.220	.070	.160	.030
I	G	.110	.265	.110	.165	.050
P	H	.150	.285	.110	.185	.050

Dimensions—mm

Case Code		(W) Width ±0.381	(L) Length ±0.381	(H) Height ±0.381	(S) Spacing Typical	(B) Pad Width ±0.127
49BC	CWR06					
B	A	1.27	2.54	1.27	1.02	0.76
L	B	1.27	3.81	1.27	2.29	0.76
U	C	1.27	5.08	1.27	3.55	0.76
E	D	2.54	3.81	1.27	2.29	0.76
C	E	2.54	5.08	1.27	3.55	0.76
H	F	3.43	5.59	1.78	4.06	0.76
I	G	2.79	6.73	2.79	4.19	1.27
P	H	3.81	7.25	2.79	4.70	1.27

Case Outline Drawing



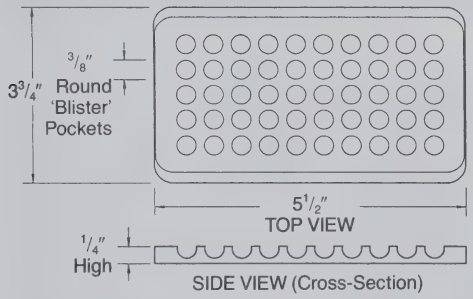
Notes:

1. For polarity identification, when chip is in mounting position, bare metal clip and weld stub are positive. The top surface of the negative terminal is blue.
2. Metric Equivalents are for general information purposes only and are based on 1″ = 25.4 mm.
3. Anode Riser (Weld Stub) may extend case size Length dimension by 0.015″ (.38 mm) max.
4. Dimensions given are for gold-plated terminations. For solder-dipped terminations, add +0.015″ (.38 mm) to dimension tolerances.
5. Spacing dimension is typical distance between chip mounting terminations and therefore average distance between mounting pads on substrate.

Packaging

Blister-Pack Trays

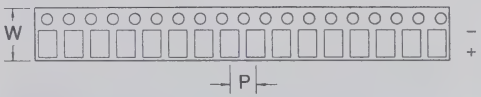
49BC Series capacitors are shipped in 'Blister Pack' trays containing 50 pieces each in a 5 × 10 matrix configuration. The Blister Pack provides a separate pocket for each unit to prevent damage to the capacitors during shipping, handling and storage.



Blister Pack trays are stamped polystyrene with a clear plastic cover. Orientation of the capacitors within the pockets is random with respect to polarity and mounting surface. This packaging is ideal for hand placement of the capacitors as it takes up very little room at a work station. It is recommended that operators remove and work with the BLUE CHIPs using a blunt, coated tweezer to prevent damage to the Blue Seal conformal coating.

Tape & Reel

49BC Series capacitors are available in Tape & Reel packaging to facilitate the use of automatic placement equipment. Tape & Reel is per EIA (Electronic Industries Association) specification RS-481A. Capacitor orientation within tape pockets is negative terminal toward sprocket holes and mounting side down. 8 and 12 mm tape widths are used according to case size. Quantities less than minimum reel will be shipped in Blister Pack trays.



Tape & Reel Specifications

49BC Case Code	CWR06 Case Code	(W) Tape Width	(P) Unit Pitch Ctr/Ctr	Quantity per full 7″ Reel	Minimum Quantity per Reel
B	A	8 mm	4 mm	3,000	1,500
L	B	12 mm	4 mm	3,000	1,500
U	C	12 mm	4 mm	3,000	1,500
E	D	12 mm	4 mm	2,700	1,350
C	E	12 mm	4 mm	2,700	1,350
H	F	12 mm	8 mm	1,000	500
I	G	12 mm	8 mm	700	350
P	H	12 mm	8 mm	700	350

BLUE CHIP Characteristics

From the least expensive BLUE CHIP, the 49BC Industrial Grade, to the Established Reliability CWR06 'R' Level chips, all members of the BLUE CHIP Family of capacitors share many of the same attributes and characteristics. All BLUE CHIP capacitors share the same design and construction and utilize the same materials and manufacturing processes. The main distinction between the different grades is typically the conditioning of the capacitor, test sequences used and the acceptance criteria that apply.

Features and characteristics common to all grades are listed here, and differences between the grades are pointed out on the following pages in a specific discussion about each of the family members.

Design and Construction

Each BLUE CHIP capacitor consists of a highly purified sintered tantalum anode body utilizing an electrolitically formed (tantalum pentoxide) dielectric and a solid (manganese dioxide) electrolyte. The shock & vibration resistant solderable terminals are attached to the capacitor body which is then protected against normal electronic equipment environments by Philips Components proprietary Blue Seal process.

The Blue Seal process completely insulates the BLUE CHIP from the circuit. No additional insulation need be specified. Only the mounting terminals are exposed. The terminals are made of 0.005" thick nickel that is plated with 100 micro inches of gold or hot solder dipped with 60/40 tin/lead solder. The terminals are specifically designed for all standard mounting techniques. All terminal materials meet the requirements of MIL-STD-1276 and MIL-G-45204.

Marking

The small physical size of the BLUE CHIP does not permit alphanumeric marking on the body of the capacitor. Color dots on the body of the capacitor are available on special order. Series 49BC capacitors are identified on their container package.

Surface Mount Application

BLUE CHIP capacitors are ideally suited for use on SMT circuit boards where circuit density requires the use of components with the highest cap/unit volume efficiency. The compliant body coating permits conductive lines to be run underneath the body of the capacitor for maximum circuit density.

Current solder reflow techniques such as Belt Reflow, IR (Infra-Red), Wave Soldering and Vapor Phase may be utilized with these capacitors.The BLUE CHIP's unique construction enables it to withstand soldering temperatures for longer durations than other types of tantalum chip construction. Multiple reflows may be made with no degradation to the capacitor's physical or electrical characteristics.

All substrate materials and all common cleaning solvents used in the industry are compatible with the BLUE CHIP.

Automatic placement equipment may be used by specifying Tape & Reel packaging.

Capacitance—Dissipation Factor—DC Leakage

- Capacitance shall be measured at or referred to 120 Hz at 25°C. Maximum DC bias is 2.2 V. AC signal shall not exceed 1.0 VRMS.
- Tolerance—available in 20%, 10% and 5% cap tolerances. Other tolerances are available under 'Customer Specials.'

−55°C	+ 85°C	125°C
−10% △	+ 10% △	+ 15% △

Capacitance Change with Temperature from 25°C readings (maximum change)

- Dissipation Factor—Limits for DF are specified under Industrial Grade or CWR06. Refer to specific DF tables.
- DC Leakage—Limits for DCL are specified under Industrial Grade or CWR06. Refer to specific DCL tables.
- DCL shall be measured at WVDC after a 5 minute electrification period with a 1000 ohm current limiting resistor in series.

Voltage Rating

All BLUE CHIPS can be used at elevated temperatures when the working voltage is derated in accordance with the following table:

Rated WVDC −55°C to 85°C	Derated (DC) 125°C	Surge Voltage (DC) 85°C	Surge Voltage (DC) 125°C
4	2.7	5.0	3.2
6	4.0	8.0	4.8
10	7.0	13.0	8.0
15	10.0	20.0	12.0
20	13.0	26.0	18.0
25	17.0	32.0	20.0
35	23.0	46.0	28.0
50	33.0	65.0	40.0

The surge voltage is the maximum DC voltage, including AC or other pulses applied for short duration.

Reverse Voltage

Series 49BC BLUE CHIP capacitors will withstand momentary voltage reversals up to 15% of their rated voltage at 25°C, 10% at 55°C, 5% at 85°C and 1% at 125°C.

Polarity

Series 49BC capacitors are polar devices intended for applications involving D.C. circuits. Proper polarity must be observed or damage to the capacitor and/or the circuit will result. Polarity is indicated when looking at the non-mounting (top) surface by the bare metal terminal on the positive end and the Blue Seal covered terminal on the negative end.

AC Power Dissipation

Case Code	Maximum Power Dissipation in Watts Ambient Temperature		
	25°C	85°C	125°C
B	.063	.056	.025
L	.075	.067	.030
U	.081	.073	.032
E	.095	.085	.038
C	.100	.090	.040
H	.125	.112	.050
I	.150	.135	.060
P	.200	.180	.080

Major physical factors which limit the ability of the capacitor to dissipate internally generated heat produced during AC circuit operation, include unit construction features as related to a particular capacitor design, and heat transfer characteristics of the materials used in the construction of the capacitor. Larger volumetric packages exhibiting electrical characteristics similar to those of smaller physical packages will, under similar conditions, be capable of dissipating more power. Conformally coated capacitors, such as the BLUE CHIP series, exhibit more efficient heat dissipation capabilities, due to the absence of relatively thick thermally insulative coatings, as incorporated in "molded" tantalum chip capacitor styles.

Maximum power dissipation levels shown represent an empirically determined wattage level required to cause a 10 degree centrigrade temperature increase above the stated temperature in "still air" as measured on the external capacitor body, utilizing a thermo-couple or other appropriate measuring device.

AC Ripple Current

Circuit design and physical layout should provide "cool" circuit board locations for capacitors operating at high AC current levels. Capacitor temperature may increase due to heat transfer/absorption from the ambient environment or a "hot" component mounted in close proximity to the capacitor. The result of increased AC current is increased internal heat generation within the capacitor body. Waveform envelope is also a factor in the amount of internal heat generated within the capacitor since non-sinusoidal waveshapes produce heating effects different than those of sinusoidal waveforms.

The ripple current and voltage level impressed across the capacitor should not exceed the maximum power dissipation of the capacitor unless special provisions are made to increase the rate of heat dissipation in tantalum chip capacitors may cause catastrophic failure. The I_{max} value of current must be used to determine the operating conditions.

The maximum permissible AC (rms) current applied across the capacitor is related to the equivalent series resistance (ESR) and the physical power dissipation capability of the capacitor. The maximum (rms) ripple current at a given frequency may be determined by:

$$I_{max}(rms) = \sqrt{Pdm/ESR}$$

where...Pdm = Maximum Power Dissipation in watts, at the maximum circuit operating temperature

$$ESR = \frac{1}{2\pi * \text{AC Frequency} * \text{Capacitance}} * \text{D.F.}$$

AC Frequency is in Hertz
Capacitance is in Farads
Dissipation Factor is in decimal form

AC Ripple Voltage

The maximum AC ripple voltage at the applied frequency must be limited to an rms value which permits only the recommended maximum power dissipation specified for a given case code.

The maximum AC ripple voltage must be determined by:

$$E_r(rms) = Z\sqrt{Pdm/ESR}$$

where...E_r = AC Ripple Voltage
Z is the Impedance in ohms
Pdm is the Maximum Power Dissipation in watts, at the maximum circuit operating temperature ESR is the Equivalent Series Resistance in ohms

Both voltage and current levels at a given frequency must be maintained so as not to exceed the recommended maximum power dissipation levels at the maximum circuit operating temperature. The DC bias voltage applied in series with the AC source applied across polar style capacitors, on which the AC voltage is "riding," may be ignored when considering the heating effects of AC current on the capacitor. The positive peak AC voltage plus the DC voltage must not exceed the rated DC voltage of the capacitor. The negative peak AC voltage in combination with the DC voltage may not obtain a level which will damage the dielectric due to reverse voltage being applied across a polar solid electrolyte tantalum chip capacitor.

Conditioning

All BLUE CHIP capacitors are given a 100% low impedance power burn-in at 85°C prior to shipment to improve performance in low impedance circuits where high current surges may occur in the capacitor.

49BC Industrial Grade

The presence of an 'A' in the 14th position of the BLUE CHIP part number specifies an Industrial Grade capacitor. While sharing many of the characteristics of its high reliability counterparts, the conditioning of the Industrial Grade BLUE CHIP is not as extensive. Electrical limits for Industrial Grade are listed in the table below.

CS3000 High Reliability

The CS3000 High Reliability BLUE CHIP originated as a Customer Special in the mid 1970's. This variation on the BLUE CHIP series was developed to satisfy requirements of battery operated circuits for a capacitor that was small in size, low in DC leakage and would provide extended long term life.

The CS3000 is specially processed and conditioned to retain its ultra low leakage characteristics through all subsequent hybrid manufacturing processes and conditioning sequences.

Starting as a basic minimum with an 'M' Level CWR06 (1% per thousand hours Established Reliability Failure Rate), the CS3000 is further 100% conditioned by thermal shock and additional low impedance aging to provide an extraordinarily reliable, extremely stable capacitor.

From its early stages, the CS3000 has become the standard tantalum chip capacitor of choice for such diverse battery operated applications as medical electronics and satellite systems.

To specify CS3000 High Reliability BLUE CHIPS, use an 'X' as the 14th character of the 49BC part number (see Part Number Designation, this section) and state CS3000 after the part number.

Limits for Dissipation Factor and DC Leakage on CS3000 BLUE CHIPs are typically specified by the customer. When limits are not specified prior to purchase, the CWR06 electrical limit table will be used.

Industrial Grade BLUE CHIP Electrical Limits & Case Codes

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	DF 120Hz %	ESR (max)* 120Hz Ω	100KHz Ω	Case Code
2.2	4	0.5	5	7	6	36	9.0	B
4.7	4	0.5	5	7	6	17	5.5	L
6.8	4	0.5	5	7	6	12	3.5	U
10	4	0.5	5	7	8	11	2.0	E
15	4	0.6	6	8	8	7	1.5	C
33	4	1.4	14	18	8	3	1.0	H
68	4	2.8	28	35	10	2	0.8	I
100	4	4.0	40	48	10	2	0.5	P
1.5	6	0.5	5	7	6	53	9.0	B
3.3	6	0.5	5	7	6	24	5.5	L
4.7	6	0.5	5	7	6	17	3.5	U
6.8	6	0.5	5	7	6	12	2.0	E
10	6	0.6	6	8	8	11	1.5	C
22	6	1.4	14	18	8	5	1.0	H
47	6	2.9	29	36	10	3	0.8	I
68	6	4.0	40	48	10	2	0.7	P
1.0	10	0.5	5	7	6	80	9.0	B
2.2	10	0.5	5	7	6	36	5.5	L
3.3	10	0.5	5	7	6	24	3.5	U
4.7	10	0.5	5	7	6	17	2.0	E
6.8	10	0.7	7	9	6	12	2.0	C
15	10	1.5	15	19	8	7	1.0	H
33	10	3.0	30	36	10	4	0.8	I
47	10	4.7	47	59	10	3	0.7	P
.68	15	0.5	5	7	6	120	10.0	B
1.5	15	0.5	5	7	6	53	6.0	L
2.2	15	0.5	5	7	6	36	4.0	U
3.3	15	0.5	5	7	6	24	2.5	E
4.7	15	0.8	8	10	6	17	2.5	C
10	15	1.5	15	19	6	8	1.5	H
22	15	3.3	33	42	8	5	1.0	I
33	15	5.0	50	60	8	3	0.8	P
.47	20	0.5	5	7	6	170	12.0	B
.68	20	0.5	5	7	6	120	8.0	L

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	DF 120Hz %	ESR (max)* 120Hz Ω	100KHz Ω	Case Code
1.0	20	0.5	5	7	6	80	8.0	L
1.5	20	0.5	5	7	6	53	8.0	U
2.2	20	0.5	5	7	6	36	3.5	E
3.3	20	0.7	7	9	6	24	3.0	C
6.8	20	1.4	14	18	6	12	2.5	H
15	20	3.0	30	36	6	6	1.0	I
22	20	4.0	40	48	6	4	1.0	P
.33	25	0.5	5	7	6	240	15.0	B
.68	25	0.5	5	7	6	120	10.0	L
1.0	25	0.5	5	7	6	80	8.0	U
1.5	25	0.5	5	7	6	53	5.0	E
2.2	25	0.6	6	8	6	36	3.5	C
4.7	25	1.2	12	15	6	17	2.5	H
6.8	25	1.7	17	22	6	12	2.0	I
10	25	2.5	25	32	6	8	2.0	I
15	25	3.8	38	48	6	6	1.0	P
.22	35	0.5	5	7	6	360	18.0	B
.47	35	0.5	5	7	6	170	12.0	L
.68	35	0.5	5	7	6	120	9.0	U
1.0	35	0.5	5	7	6	80	6.0	E
1.5	35	0.6	6	8	6	53	5.0	C
3.3	35	1.0	10	12	6	24	2.5	H
4.7	35	1.7	17	22	6	17	2.5	I
6.8	35	2.4	24	30	6	12	2.0	P
.10	50	0.5	5	7	6	800	20.0	B
.15	50	0.5	5	7	6	530	20.0	B
.22	50	0.5	5	7	6	360	15.0	L
.33	50	0.5	5	7	6	240	15.0	L
.47	50	0.5	5	7	6	170	10.0	U
.68	50	0.5	5	7	6	120	8.0	E
1.0	50	0.5	5	7	6	80	6.0	C
1.5	50	0.8	8	10	6	53	5.0	H
2.2	50	1.1	11	14	6	36	3.5	H
3.3	50	1.7	17	22	6	24	2.5	I
4.7	50	2.4	24	30	6	17	2.5	P

*120Hz ESR is maximum at nominal capacitance

49BC Customer Specials (CS)

Special requests from our customers over the years for tantalum chip product that exceeds catalog specifications have given us the opportunity and the impetus to develop application specific chip tantalums with tighter limits and better operating parameters.

Recognizing the diverse requirements of many of our customers, Philips Components established the Technical Services Department to act as liaison between our customers and our design, applications and reliability engineering groups.

Typical of the design and application problems we've helped solve with product built as 'customer special':

- Low ESR at high frequency capacitors for applications such as switch-mode power supplies.
- Modular assemblies for high capacitance density.
- Adherence to rigid size restrictions far beyond normal.
- Fabrication of non-polar tantalum chips.
- Specialized cap shifts (with frequency) for wide-band amplifiers and microwave applications.
- Fibre-Optics coupling capacitors.
- Closely matched pairs for critical timing circuits.
- Electrical parameter limits for Customer Special BLUE CHIPS are not specified here because they are not specified by us. If you have a non-standard application for tantalum chips, call us and let our Technical Services Department review it with you.

CWR06 Established Reliability

Series 49BC BLUE CHIP capacitors are qualified to both Exponential Failure Rate Levels (M, P and R) and Weibull Graded Failure Rate Levels (B, C and D) under specification MIL-C-55365/4, Style CWR06.

The military part numbering system and electrical parameter limits for Dissipation Factor and DC Leakage are covered on the following pages. Test information from the military specification follows that, but it is recommended that you obtain the specification and its attendant documents for further clarification of tests and procedures.

Philips Components provides either "B" or "C" termination styles for CWR06 BLUE CHIPs. Among the industry-recognized advantages attributed to 60/40 hot soldered terminations are:

- The only form of coating to insure sufficient solder to meet solder fillet requirements of MIL-STD-883 ("C" termination only).
- A termination that will withstand to steam aging (8 hours) and meet solderability requirements of MIL-STD-202, method 108.
- Allows long term storage for up to a year and still meets solderability requirements for MIL-STD-202.

Additional BLUE CHIP Physical Statistics

Case Codes		Physical Statistics				Typical Weight (grams)
		Substrate Area		Typical Volume		
BC	Mil	sq. in.	sq. cm.	cu. in.	cu. cm.	
B	A	0.00500	0.0323	0.000250	0.0041	0.02
L	B	0.00750	0.0484	0.000375	0.0062	0.03
U	C	0.01000	0.0645	0.000500	0.0082	0.04
E	D	0.01500	0.0967	0.000750	0.0123	0.07
C	E	0.02000	0.1290	0.001000	0.0164	0.09
H	F	0.02970	0.1930	0.001800	0.0295	0.21
I	G	0.02915	0.1880	0.003200	0.0524	0.33
P	H	0.04275	0.2760	0.004700	0.0770	0.50

Style CWR06 Established Reliability

Military Style Tantalum Chip Capacitors

MIL-C-55365/4 Military Part Numbering System Example

CWR06 C B 225 K P

- P — **Failure Rate in percent per 1,000 hours**: M = 1%, B = 0.1%, P = 0.1%, C = 0.01%, R = 0.01%, D = 0.001%
- K — **Capacitance Tolerance**: J = 5%, K = 10%, M = 20%
- 225 — **Capacitance, Nominal, in Picofarad Code**: First two digits are significant figures, third digit is number of zeros to follow.
- B — **Termination Finish**: B = Gold Plated Nickel (100 μ" Gold), C = Hot Solder Dipped (60/40)
- C — **Rated Voltage at 85°C**: C = 4, D = 6, F = 10, H = 15, J = 20, K = 25, M = 35, N = 50
- CWR06 — **Style CWR06 Tantalum Chip Capacitor**

NOTE: Military Part number does not designate case code

CWR06 Electrical Limits & Military Case Codes

Cap. (nom) μF	Rated VDC 85° C	DC Leakage (max) 25°C μA	85°C μA	125°C μA	Dissipation Factor (max) 25°C %	85°C 125°C	−55°C %	Case Code (Mil)
2.2	4	1.0	10	12	6	8	8	A
4.7	4	1.0	10	12	6	8	8	B
6.8	4	1.0	10	12	6	8	8	C
10	4	1.0	10	12	8	8	10	D
15	4	1.0	10	12	8	10	12	E
33	4	2.0	20	24	8	10	12	F
68	4	3.0	30	36	10	12	12	G
100	4	4.0	40	48	10	12	12	H
1.5	6	1.0	10	12	6	8	8	A
3.3	6	1.0	10	12	6	8	8	B
4.7	6	1.0	10	12	6	8	8	C
6.8	6	1.0	10	12	6	8	8	D
10	6	1.0	10	12	8	10	12	E
22	6	2.0	20	24	8	10	12	F
47	6	3.0	30	36	10	12	12	G
68	6	4.0	40	48	10	12	12	H
1.0	10	1.0	10	12	6	8	8	A
2.2	10	1.0	10	12	6	8	8	B
3.3	10	1.0	10	12	6	8	8	C
4.7	10	1.0	10	12	6	8	8	D
6.8	10	1.0	10	12	6	8	8	E
15	10	2.0	20	24	8	8	10	F
33	10	3.0	30	36	10	12	12	G
47	10	5.0	50	60	10	12	12	H
.68	15	1.0	10	12	6	8	8	A
1.5	15	1.0	10	12	6	8	8	B
2.2	15	1.0	10	12	6	8	8	C
3.3	15	1.0	10	12	6	8	8	D
4.7	15	1.0	10	12	6	8	8	E
10	15	2.0	20	24	6	8	8	F
22	15	4.0	40	48	8	8	10	G
33	15	5.0	50	60	8	8	10	H
.47	20	1.0	10	12	6	8	8	A
.68	20	1.0	10	12	6	8	8	B

Cap. (nom) μF	Rated VDC 85° C	DC Leakage (max) 25°C μA	85°C μA	125°C μA	Dissipation Factor (max) 25°C %	85°C 125°C	−55°C %	Case Code (Mil)
1.0	20	1.0	10	12	6	8	8	B
1.5	20	1.0	10	12	6	8	8	C
2.2	20	1.0	10	12	6	8	8	D
3.3	20	1.0	10	12	6	8	8	E
6.8	20	2.0	20	24	6	8	8	F
15	20	3.0	30	36	6	8	8	G
22	20	4.0	40	48	6	8	8	H
.33	25	1.0	10	12	6	8	8	A
.68	25	1.0	10	12	6	8	8	B
1.0	25	1.0	10	12	6	8	8	C
1.5	25	1.0	10	12	6	8	8	D
2.2	25	1.0	10	12	6	8	8	E
4.7	25	2.0	20	24	6	8	8	F
6.8	25	2.0	20	24	6	8	8	G
10	25	3.0	30	36	6	8	8	G
15	25	4.0	40	48	6	8	8	H
.22	35	1.0	10	12	6	8	8	A
.47	35	1.0	10	12	6	8	8	B
.68	35	1.0	10	12	6	8	8	C
1.0	35	1.0	10	12	6	8	8	D
1.5	35	1.0	10	12	6	8	8	E
3.3	35	1.0	10	12	6	8	8	F
4.7	35	2.0	20	24	6	8	8	G
6.8	35	3.0	30	36	6	8	8	H
.10	50	1.0	10	12	6	8	8	A
.15	50	1.0	10	12	6	8	8	A
.22	50	1.0	10	12	6	8	8	B
.33	50	1.0	10	12	6	8	8	B
.47	50	1.0	10	12	6	8	8	C
.68	50	1.0	10	12	6	8	8	D
1.0	50	1.0	10	12	6	8	8	E
1.5	50	1.0	10	12	6	8	8	F
2.2	50	2.0	20	24	6	8	8	F
3.3	50	2.0	20	24	6	8	8	G
4.7	50	3.0	30	36	6	8	8	H

MIL-C-55365/4—Test and Conditions (Excerpts from the Military Specification)

Capacitance

Capacitors shall be tested in accordance with MIL-STD-202, method 305. The following details shall apply:

(a) Test frequency: 120 ±5 Hertz.
(b) Limit of accuracy: Measurement accuracy shall be within ±2 percent of the reading.
(c) Magnitude of polarizing voltage—Maximum DC bias shall be 2.2 volts for all AC measurements. The magnitude of the AC voltage shall be limited to 1.0 volts RMS.

Dissipation Factor

The dissipation factor of each capacitor shall be measured at a frequency of 120 ±5 Hertz (Hz) by means of a polarized capacitance bridge. The bridge shall provide a dial reading accuracy of 0.1% dissipation factor and a measuring accuracy of ± (2 percent of the measured dissipation factor plus 0.1%).

D.C. Leakage

D.C. leakage shall be measured using the DC rated voltage at ±2 percent at the applicable test temperature after a maximum electrification period of 5 minutes. A 1,000-ohm resistor shall be placed in series with the capacitor to limit the charging current. A steady source of power, such as a regulated power supply, shall be used. Measurement accuracy shall be within ±2 percent or 0.02 microamps (μa), whichever is greater.

Thermal Shock

Capacitors shall be tested in accordance with MIL-STD-202, method 107. The following details and exceptions shall apply:

(1) Mounting of specimens: Chip capacitors shall be mounted on suitable substrate. The substrate material shall be such that it shall not be cause of, nor contribute to, failure of any test for which it may be used. The capacitors shall be mounted on the substrate as follows:
  (a) A substrate shall be prepared with metalized surface land areas of proper spacing to permit mounting of chips by soldering the terminations of the chips to the "test card" land areas.
  (b) Solder paste, type "R" or "RMA" in accordance with QQ-S-571, shall be applied to terminals or substrates as applicable.
  (c) The chip shall then be placed across the metalized land areas of the substrate so as to make contact between chip and substrate land areas.
  (d) The substrate shall then be placed in or on a suitable heat transfer unit at a temperature of 135°C ±15°C for 1.0 ±0.1 minute. The substrate shall then be placed upon or enter the 245°C ±5°C hot-plate or tunnel oven. The substrate shall remain on the hot-plate or tunnel oven at 245°C ±5°C until the solder paste melts and reflows forming a homogeneous solder bond to the metalized substrate.
  (e) All excess flux or solder shall be removed.
(2) Test condition letter: B
(3) Measurements after thermal shock: DC leakage —meet original requirement; Capacitance—shall change no more than 5% from initial measurement; Dissipation Factor—meet original requirement.
(4) Visual requirements: There shall be no evidence of harmful corrosion or mechanical damage.

Vibration, High Frequency

Capacitors shall be tested in accordance with MIL-STD-202, method 204, The following details and exceptions shall apply:

(a) Mounting of specimens—Capacitors shall be mounted on a substrate as specified under thermal shock.
(b) Electrical-load conditions—During the test, the specified DC rated voltage shall be applied to the capacitors.
(c) Test condition letter—D (20 G's).
(d) Duration and direction of motion—4 hours in each of two mutually perpendicular directions (total of 8 hours), one parallel and the other perpendicular to the axis.
(e) Measurements during vibration—During the last cycle, an electrical measurement shall be made to determine intermittent operation or open or short circuiting. Observations shall also be made to determine intermittent contact or arcing or open or short circuiting. Detecting equipment shall be sufficiently sensitive to detect any interruption with a duration of 0.5 ms or greater.
(f) Measurements after vibration—Not applicable.
(g) Examination after test—Capacitors shall be visually examined for evidence of mechanical damage.

Resistance to Soldering Heat

Capacitors shall be tested in accordance with MIL-STD-202, method 210. The following details and exceptions shall apply:

(a) Mounting of specimens—Chip Capacitors shall be mounted on a substrate as specified in Thermal Shock except the post pre-heat hot-plate temperature shall be 260°C ±5°C for a duration of 5 seconds ±0.5 second.
(b) Test condition letter—C.
(c) Post test conditioning: The capacitors shall be inserted in a vapor degreasing apparatus containing boiling 1-1-1 trichloroethane for 1.5 minutes +0.5, −0 minute. The parts shall then be cleaned with isopropyl alcohol.
(d) Measurements after test: Following a minimum 3 hour cooling period: DC leakage-meet original requirement; Capacitance-shall change not more than ±5 percent from initial measurement; Dissipation Factor-meet original requirement.
(e) Examination after test—Capacitors shall be visually examined for evidence of mechanical damage.

Moisture Resistance

Capacitors shall be tested in accordance with MIL-STD-202, method 106. The following details and expections shall apply:

(a) Mounting of specimens—Capacitors shall be mounted as specified in Thermal Shock.
(b) Initial measurements—Capacitance as specified above.
(c) Number of cycles—20 continuous cycles except that steps 7a and 7b shall be omitted.
(d) Loading voltage—Not applicable.
(e) Final measurements—After removal from chamber, capacitors shall be dried for 1 hour at room temperature and, within the next hour, DC leakage, Capacitance and Dissipation Factor shall be measured as specified above.
(f) Examination after test—Capacitors shall be visually examined for evidence of corrosion and mechanical damage.

When tested as specified, capacitors shall meet the following requirements:

- DC leakage—Shall not exceed 200% of the requirement specified.
- Capacitance—Shall not change more than ±15% from the initial measured value.
- Dissipation Factor—Shall not exceed 150% of the requirement specified.
- Visual examination—There shall be no evidence of harmful corrosion or mechanical damage.

Stability at Low and High Temperature

Capacitors shall be dried at 125°C for 30 (+4, −0) minutes prior to start of test. The capacitors shall be brought to thermal stability at each test temperature. Thermal stability will have been reached when no further change in capacitance is observed between two successive measurements taken at 15, +2 −0 minute, intervals. Capacitors will meet the following requirements as applicable:

Step 1 (25°C Initial measurements):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within tolerance of the nominal value.
Dissipation factor—Shall not exceed the requirement specified.

Step 2 (−55°C):
Capacitance—Shall be within ±10% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 3 (25°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within ±5% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 4 (85°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within ±10% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 5 (125°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within ±15% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 6 (25°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within ±5% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Surge Voltage

Capacitors shall be subjected to 1,000 cycles of the applicable surge voltage. The ambient temperature during cycling shall be 85°C. Each cycle shall consist of a 30-second surge voltage application followed by a 30-second discharge period. Voltage application shall be made through a resistor of 33 ohms. The tolerance of the resistor shall be ±5 percent. Each surge voltage cycle shall be performed in such a manner that the capacitor is shorted terminal-to-terminal through a copper bar, or an equivalent low resistance at the end of the 30-second application. An alternative method of shorting the capacitors is discharge through the same resistance that is utilized for charging. After the final cycle, the capacitor shall be stabilized at the inspection conditions, and the DC leakage, Capacitance, and DF shall be measured. When tested as specified, capacitors shall meet the following requirements:

DC Leakage—Shall not exceed the requirement specified.
Capacitance—Shall change not more than ±5% from initial value.
Dissipation Factor—Shall not exceed the requirement specified.

Life Test

A. Capacitors shall be tested in accordance with MIL-STD-202, method 108. The following details and exceptions shall apply:
   (a) Method of mounting—as detailed under thermal shock.
   (b) Test conditions
      (1) Proof Life
         2,000 hours
         125°C
         Derated voltage applied
      (2) Failure Rate Life
         10,000 hours
         85°C
         Rated voltage applied
B. Operating conditions—DC rated voltage 85°C or derated voltage at 125°C, as applicable, shall be applied gradually (not to exceed 5 minutes) either by a slow build up of the voltage or through a resistor which shall be shorted out within 5 minutes. Voltage shall be applied continuously except during measurement period. The impedance of the voltage source, as seen from the terminals of each capacitor, shall not exceed three ohms. Storage batteries or an electronic power supply capable of supplying at least one ampere when a capacitor is shorted shall be used.
C. Measurements during exposure—DC leakage, at the applicable high test temperature and voltage, shall be measured at the following intervals: 0 hours, 240 hours, 1000 hours, 2000 hours, 4000 hours*, 6000 hours*, 8000 hours*, 10,000 hours*.
   *Failure rate (85°C) life only.
D. Measurements after exposure—Capacitors shall be returned to 25°C and visually examined for evidence of harmful corrosion or mechanical damage. DC leakage, Capacitance and Dissipation Factor will then be measured as specified.

Following testing there shall be no evidence of harmful corrosion or mechanical damage and the capacitors will meet the following electrical requirements:

2,000 hours:
- at 25°C: DCL—initial requirement.
  △ Cap—±5% of initially measured value.
  DF—initial requirement.
- at 85°C: DCL—initial requirement.
- at 125°C: DCL—initial requirement.

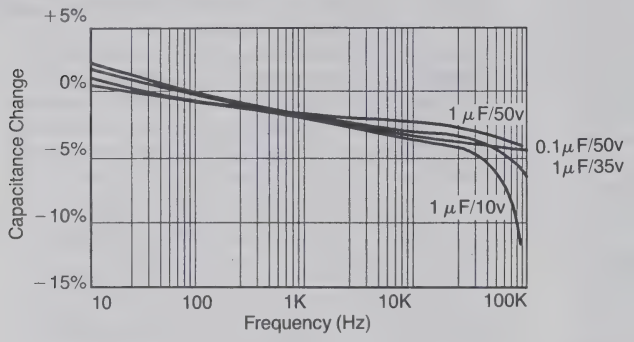
10,000 hours:
- at 25°C: DCL—200% of initial requirement.
  △ Cap—within ±10% of initial measurement.
  DF—initial requirement.
- at 85°C: DCL—200% of initial requirement.
- at 125°C: DCL—200% of initial requirement.

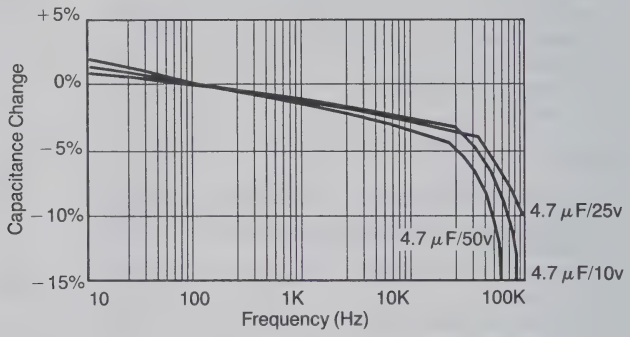
Solderability

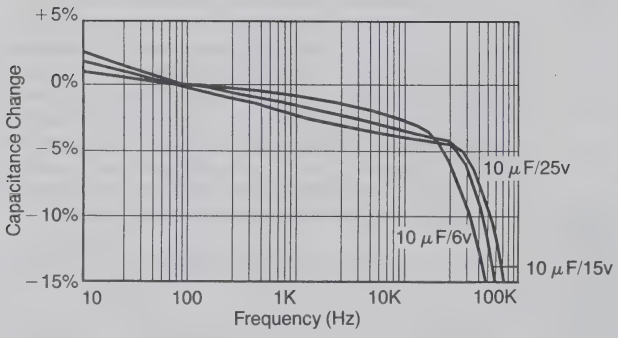
Capacitors shall be tested in accordance with MIL-STD-202, method 208. Mounting surfaces shall be dipped to cover the normal mounting surfaces. After the test, the solderable surface shall be at least 95% covered with a smooth solder coating and shall exhibit no demetallization or leaching of the terminal ends. The remaining 5% may contain only small pin holes or rough spots, these shall not be concentrated in one area. The area surrounding the anode connection and the .005″ thick edges of the termination are not specified as solderable surfaces.

Typical Characteristics

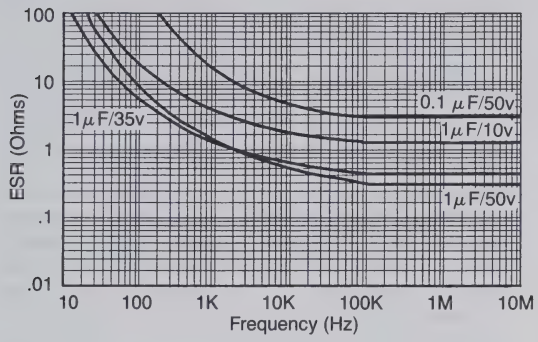
Capacitance Change with Frequency

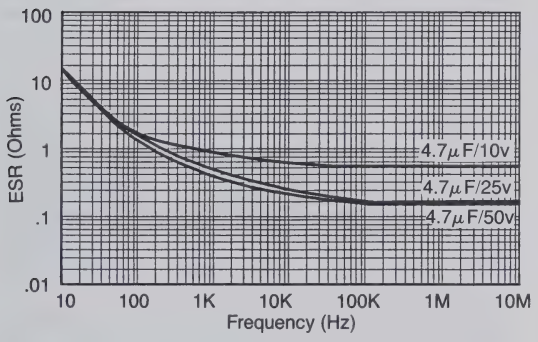


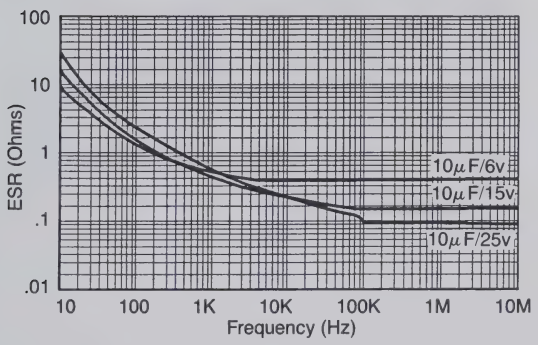




Equivalent Series Resistance vs Frequency







Application Notes

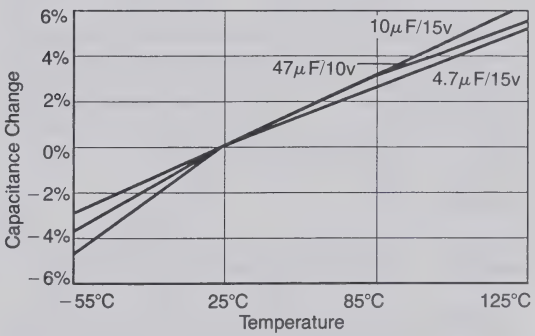
Designing with BLUE CHIPs

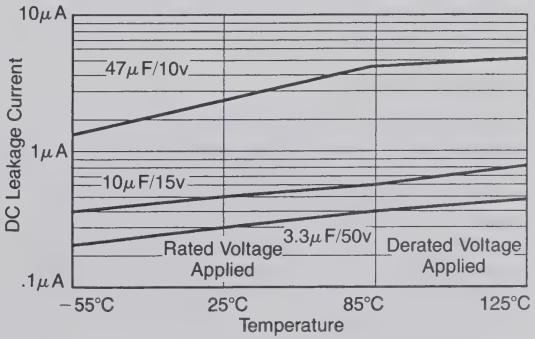
Philips Components BLUE CHIP Series capacitors are designed for use in thin and thick film hybrid circuits utilizing a variety of mounting techniques and in surface mount applications where soldering times and temperatures preclude the use of other styles of tantalum chip construction. BLUE CHIPs are an excellent choice for circuit applications involving filtering, coupling, decoupling, bypass and timing.

Operating Temperature

BLUE CHIP capacitors are intended for circuits operating at rated voltage between – 55°C and 85°C. When linearly derated to 2/3 of working voltage, operation to 125°C is allowed.

Temperature Characteristics



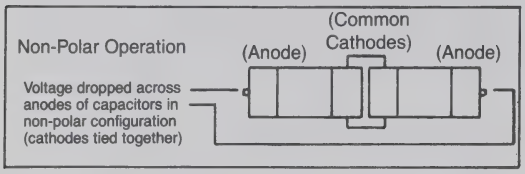


Reliability Derating

At normal operating temperatures, BLUE CHIP capacitors can be operated at less than rated voltage with a proportionate increase in reliability and no degradation of capacitor electrical parameters.

Non-Polar Configuration

In circuits where voltage reversals exceeding 15% at 25°C occur, or where AC ripple voltages are high, BLUE CHIPs should be mounted in pairs in a cathode to cathode arrangement to effect non-polar operation.



In these cases, if two identical BLUE CHIPs are mounted back to back, the resulting capacitance will be 1/2 the value of the original devices and the voltage rating will be the same as the rating of the original devices. The positive peak AC voltage plus the DC voltage must not exceed the rated voltage of the capacitor in either direction.

Handling

Manual: The use of vacuum pencils or plastic tipped tweezers is recommended. Specify 'Blister-Pack' packaging.

Automatic: Because BLUE CHIP capacitors are physically rugged, they can be automatically dispensed by vibration type feed bowls (specify 'Blister-Pack' packaging) or by automatic tape fed placement equipment (specify Tape & Reel packaging). Other types of packaging (as specified by customer) will be considered.

Mounting Materials

Most hybrid circuits use various materials in the substrate and pads which have differing coefficients of expansion. Therefore, Philips Components has designed its BLUE CHIP to be compatible with solder, epoxy and thermal compression bonding based upon the type termination specified. The "U" shaped termination and method of attachment isolates the capacitor from the substrate, making the BLUE CHIP totally compatible with all substrate materials, regardless of thermal mismatch.

Both conductive adhesives and solder pastes or creams lend themselves to production techniques because they can be accurately and rapidly screened onto the pads using masks. They also have a precure tackiness permitting chip placement prior to curing.

Conductive adhesives have the advantage of lower temperature cure mechanisms than those required for solder attachment. They do not require post attachment cleaning and defluxing cycles. Conductivity and joint strength will vary widely depending on the adhesive formulation and curing profile.

Soft metal solder attachment allows the widest latitude of conditions while still providing satisfactory attachment. While optimum joint strength and a low resistance connection are obtained, soldering does require a complex cleaning sequence to remove all traces of fluxes and any entrained contaminants.

BLUE CHIP termination materials are totally compatible with all soft metal solders which provide optimum joint strength over wide temperature excursions and all commercially available fluxing systems. Either water or solvent based fluxing systems may be used.

Mounting Techniques

Wire Bonding The BLUE CHIP's standard termination finish, 100 micro inches of soft gold plated over a .005″ nickel clip, provides the optimum surface for either thermal compression or ultrasonic wire bonding. Gold plated terminations must be specified for these applications. In a typical application, the chip is glued down "on its back" with the mounting side up, and two wires (repetitive connections) are bonded to each of the positive and negative terminations.

Conductive Adhesive For mounting with conductive adhesive, gold plated terminations are recommended. (A cautionary note when working with conductive adhesives: curing the adhesive at the lowest acceptable temperature for a longer time will minimize the possibility of forming "hairline" cracks in the adhesive during the cure.)

Solder Attach For mounting by means of reflow soldering, 60/40 solder dipped terminations should be specified. The exception to soft metal soldering is the use of Indium/Lead solder, in which case gold plated terminations should be specified. Any of the methods of solder reflow currently in use in the industry may be used with BLUE CHIP capacitors.

Hand Soldering It is difficult to control soldering conditions when applying heat with a soldering iron. The solder dipped BLUE CHIP is recommended because the only requirement is to melt the solder of the termination rather than raise the temperature high enough to make a metallurgical bond to the base metal. A 600°F chisel tip iron is recommended, with application of the tip to the interface between the chip termination and the substrate pad. By minimizing the time necessary to reflow the solder, a minimum of heat is transferred to the capacitor body.

Hot Plate This method has advantages over hand soldering for small quantity assembly operations. The temperature is easily controlled and all terminations are reflowed simultaneously. A reflow temperature of 230°C is recommended for alumina substrates. Higher temperatures or longer durations may be required for other substrate material. Preheating to 160°C prior to reflow will provide proper fluxing activation. Room temperature "cool-down" is all that is necessary.

Belt Reflow The advantages of this method is that it provides a uniform increase in temperature to properly activate the fluxing system prior to reflow. The setting of the temperature will depend on the mass being reflowed. The belt speed and heat source should be adjusted or alignment of components should be such that one termination of any component does not reach liquidus temperature before the other. The capillary action or surface tension of the liquid solder could pull the component askew on the pads.

Infra-Red (IR) The same recommendations apply to IR soldering as Belt Reflow with an additional caution that reflective surfaces will have an effect on heat absorption.

Wave Soldering The same recommendations as above apply to this reflow method. Additionally, pre-heating prior to immersing the capacitors in liquid solder has to be considered a necessity rather than a recommendation in order to ensure proper flux activation. Gluing of the device to the substrate is normally required prior to wave soldering.

Vapor Phase The design and construction of the BLUE CHIP and its ability to withstand longer durations at higher temperatures make it better suited for vapor phase reflow than other styles of tantalum chip construction. BLUE CHIPs will withstand the rapid rise to temperature inherent in the vapor phase system. The solid metal terminations will not de-wet.

Cleaning

The fluoroelastomer conformal coating prevents intrusion of any contaminates present in the cleaning process. It is compatible with most commonly used cleaning methods and solvents. This includes methods such as ultrasonic, hot and cold solvent sprays, vapor degreasing and detergent washes. All commercially available, commonly used solvents are compatible with the BLUE CHIP family of capacitors.

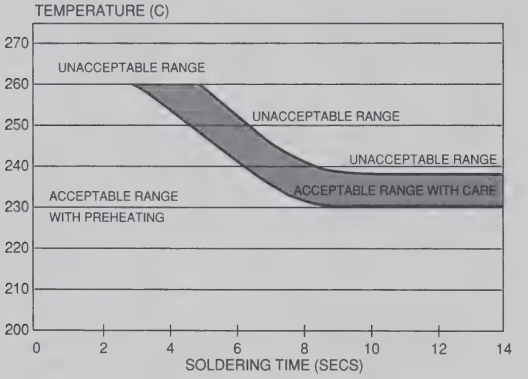
Recommended Pad Dimensions for Wave Soldering

Case Size	A Min.	B Min.	C Nom.	D Nom.
B	.044 (1.11)	.067 (1.70)	.030 (0.77)	.204 (5.17)
L	.044 (1.11)	.067 (1.70)	.080 (2.04)	.254 (6.44)
U	.044 (1.11)	.067 (1.70)	.130 (3.31)	.304 (7.71)
E	.077 (1.96)	.067 (1.70)	.080 (2.04)	.254 (6.44)
C	.077 (1.96)	.067 (1.70)	.130 (3.31)	.304 (7.71)
H	.101 (2.55)	.067 (1.70)	.150 (3.82)	.324 (8.22)
I	.084 (2.13)	.087 (2.21)	.155 (3.94)	.369 (9.36)
P	.111 (2.81)	.087 (2.21)	.175 (4.45)	.389 (9.88)

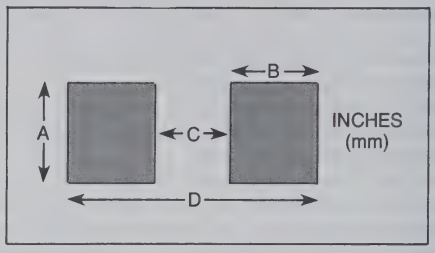
Soldering Profiles for Reflow

Soldering time and temperature should be kept to the minimum required for a good connection. Wave soldering can be very suitably performed at 230–250 degrees C over a period of 3–5 seconds. Infrared or vapor phase techniques should refer to the profile shown below. This profile ensures that the peak reflow and dwell time range does not allow the internal construction to exceed 220 degrees C. A maximum of 150 degrees C with a 10 minute dwell is recommended for the preheating profile. Slight parametric shifts in performance of the devices may be noted immediately following reflow. For this reason, it is recommended that a brief period of stabilization occur at ambient temperature prior to any electrical testing.

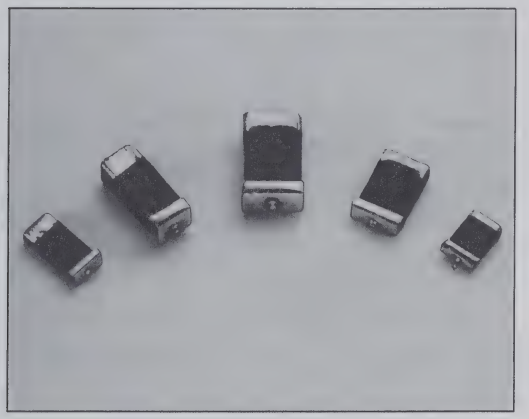
Recommended Reflow Time and Temperature



Recommended Pad Dimensions for Reflow Soldering



Case Size	A Min.	B Min.	C Nom.	D Nom.
B	.085 (2.15)	.062 (1.58)	.030 (0.77)	.204 (5.17)
L	.085 (2.15)	.062 (1.58)	.080 (2.04)	.254 (6.44)
U	.085 (2.15)	.062 (1.58)	.130 (3.31)	.304 (7.71)
E	.135 (3.42)	.062 (1.58)	.080 (2.04)	.254 (6.44)
C	.135 (3.42)	.062 (1.58)	.130 (3.31)	.304 (7.71)
H	.170 (4.31)	.062 (1.58)	.150 (3.82)	.324 (8.22)
I	.145 (3.67)	.082 (2.08)	.155 (3.94)	.369 (9.36)
P	.185 (4.45)	.082 (2.08)	.175 (4.45)	.389 (9.88)



STAR CHIP Tantalum SMD® (Chip) Capacitors Series 49SC

Description

The 49SC/STAR CHIP Series is a companion to the patented Philips Components BLUE CHIP, which has gained world-wide acceptance as the ultra high reliability capacitive component for military electronics and other sophisticated micro-electronic systems. It is a cost-effective alternative to the BLUE CHIP in high volume industrial applications.

The 49SC Series provides maximum volumetric efficiency in a conformally coated device. The capacitive element is protected from external contaminates by a proprietary conformal coating.

The STAR CHIP is available in five standard case sizes which are physically similar to the BLUE CHIP and directly pad-compatible with MIL-C-55365/4 (CWR-06 style) capacitors.

Philips Components 49SC series is especially suited for use on SMD circuit boards, as well as in thick or thin film hybrid circuits, where cap values between .47 μF and 100 μF are required.

STAR CHIP Surface Mount Devices are supplied in 12 mm embossed tape for efficiency in handling and storage as well as being compatible with all tape-fed high speed placement equipment.

Electrical characteristics such as low leakage current and low equivalent series resistance at high frequencies make the STAR CHIP an excellent choice for circuits where actual performance must be weighed against low initial cost.

Philips Components manufactures the STAR CHIP products utilizing advanced Statistical Process Control methods (SPC). The use of Statistical Process Control techniques provides a very consistent and reliable product.

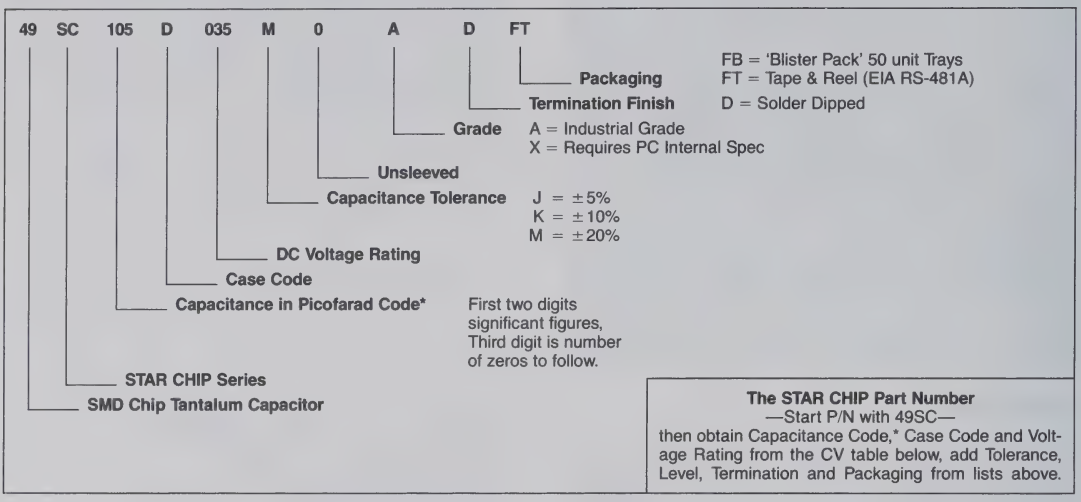
Features

- -55°C through $+85$°C Operation (125°C with Voltage Derating)
- Capacitance Range: .47 μF to 100 μF
- Rated Voltages: 4 VDC to 50 VDC
- Five Standard Case Sizes D, E, F, G, H (Pad-Compatible with CWR-06)
- Low ESR in High-Frequency Applications
- Solder-Dipped Terminations Ideally Suited for Solder Reflow Techniques
- Conformally Coated Construction Provides Maximum Volumetric Efficiency
- Uniform Physical Dimensions
- Standard 12 mm Tape & Reel Packaging

®SMD is a Service Mark of North American Philips Corporation
®STAR CHIP is a Registered Trade Mark.
The STAR CHIP is patented under US Patent No. 4,571,664

Part Number Designation

Philips Components Series 49SC Capacitors can be completely specified using the following designation:


49 SC 105 D 035 M 0 A D FT
Packaging
FB = 'Blister Pack' 50 unit Trays
FT = Tape & Reel (EIA RS-481A)
Termination Finish
D = Solder Dipped
Grade
A = Industrial Grade
X = Requires PC Internal Spec
Unsleeved
Capacitance Tolerance
J = ±5%
K = ±10%
M = ±20%
DC Voltage Rating
Case Code
Capacitance in Picofarad Code*
First two digits significant figures, Third digit is number of zeros to follow.
STAR CHIP Series
SMD Chip Tantalum Capacitor

The STAR CHIP Part Number
—Start P/N with 49SC—
then obtain Capacitance Code,* Case Code and Voltage Rating from the CV table below, add Tolerance, Level, Termination and Packaging from lists above.

Physical Specifications

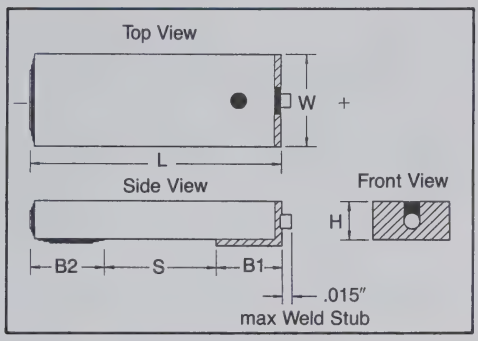
Dimensions—Inches

Case Code	(W) Width ±0.015	(L) Length ±0.015	(H) Height ±0.015	(S) Spacing Typical	(B1) +Pad Width ±0.010	(B2) −Pad Width −.010/+.025
D	.100	.150	.050	.090	.030	.030
E	.100	.200	.050	.140	.030	.030
F	.135	.220	.070	.160	.030	.030
G	.110	.265	.110	.165	.050	.050
H	.160	.275	.110	.175	.050	.050

Dimensions—mm

Case Code	(W) Width ±0.381	(L) Length ±0.381	(H) Height ±0.381	(S) Spacing Typical	(B1) +Pad Width ±0.254	(B2) −Pad Width −.254/+.635
D	2.54	3.81	1.27	2.29	0.76	0.76
E	2.54	5.08	1.27	3.56	0.76	0.76
F	3.43	5.59	1.78	4.06	0.76	0.76
G	2.79	6.73	2.79	4.19	1.27	1.27
H	4.06	7.25	2.79	4.44	1.27	1.27

Case Outline Drawing



Notes:

1. For polarity identification, when chip is in mounting position, metal "L" clip and weld stub are positive. In addition, the positive end is marked with a dot. The top negative surface is conformally coated.
2. Metric Equivalents are for general information purposes only and are based on 1″ = 25.4 mm.
3. Anode Riser (Weld Stub) may extend case size Length dimension by 0.015″ (.38 mm) max.
4. Spacing dimension is typical distance between chip mounting terminations and therefore average distance between mounting pads on substrate.

49SC Capacitance—Voltage—Case Code Table

Select standard Capacitance/Voltage ratings and corresponding standard STAR CHIP case codes from this table.

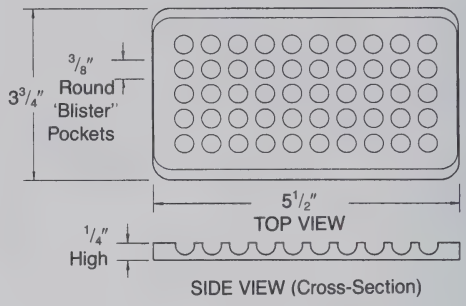
CAP µF	Picofarad Code*	004 V	006 V	010 V	015 V	020 V	025 V	035 V	050 V
0.47	474	D	D	D	D	D	D	D	D
0.68	684	D	D	D	D	D	D	D	D
1.0	105	D	D	D	D	D	D	D	E
1.5	155	D	D	D	D	D	D	E	F
2.2	225	D	D	D	D	D	E	F	F
3.3	335	D	D	D	D	E	F	F	G
4.7	475	D	D	D	E	F	F	G	H
6.8	685	D	D	E	F	F	G	H	
10.0	106	D	E	F	F	G	G		
15.0	156	E	F	F	G	G	H		
22.0	226	F	F	G	G	H			
33.0	336	F	G	G	H				
47.0	476	G	G	H					
68.0	686	G	H						
100.0	107	H							

Packaging

Blister-Pack Trays

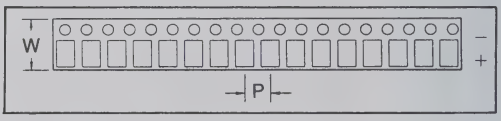
49SC Series capacitors are available in 'Blister Pack' trays containing 50 pieces each in a 5 × 10 matrix configuration. The Blister Pack provides a separate pocket for each unit to prevent damage to the capacitors during shipping, handling and storage.

Blister Pack trays are stamped polystyrene with a clear plastic cover. Orientation of the capacitors within the pockets is random with respect to polarity and mounting surface. This packaging is ideal for hand placement of the capacitors as it takes up very little room at a work station. It is recommended that operators remove and work with the STAR CHIPs using a blunt, coated tweezer to prevent damage to the conformal coating.



Tape & Reel

49SC Series capacitors are shipped in Tape & Reel packaging to facilitate the use of automatic placement equipment. Tape & Reel is per EIA (Electronic Industries Association) specification RS-481A. Capacitor orientation within tape pockets is negative terminal toward sprocket holes and mounting side down. 12 mm width tape is used. Quantities less than minimum reel will be shipped in Blister Pack trays.



Tape & Reel Specifications

49SC Case Code	(W) Tape Width	(P) Unit Pitch Ctr/Ctr	Quantity per Full 7" Reel	Minimum Quantity per Reel
D	12 mm	4 mm	2,700	1,350
E	12 mm	4 mm	2,700	1,350
F	12 mm	8 mm	1,000	500
G	12 mm	8 mm	700	350
H	12 mm	8 mm	700	350

Application Notes

Capacitance

Capacitance shall be measured at or referred to 120 Hz at 25°C. The AC signal shall not exceed 1.0 VRMS.

Tolerance Type 49SC are available in ±20%, ±10% and ±5% capacitance tolerances.

Capacitance Change with Temperature from 25°C reading (maximum):

at −55°C −10% △
at +85°C +10% △
at +125°C +15% △

Dissipation Factor (DF)
DF is determined by the same method as capacitance.

DC Leakage Current (DCL)

DCL shall be measured at WVDC after a 5 minute electrification period with a 1000 ohm current-limiting resistor in series.

Voltage Rating

STAR CHIPS can be used at elevated temperatures when voltage is derated in accordance with the following:

Rated WVDC −55°C to 85°C	Derated (DC) 125°C	Surge Voltage (DC) 85°C	Surge Voltage (DC) 125°C
4	2.7	5.0	3.4
6	4.0	8.0	5.0
10	7.0	13.0	9.0
15	10.0	20.0	12.0
20	13.0	26.0	16.0
25	17.0	32.0	20.0
35	23.0	46.0	26.0
50	33.0	65.0	38.0

STAR CHIP Electrical Limits & Case Codes

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	DC Leakage (max) 85°C µA	DC Leakage (max) 125°C µA	DF 120Hz %	ESR (max)* 120Hz Ω	ESR (max)* 100KHz Ω	Case Code
2.2	4	0.5	5	7	6	36	3.5	D
4.7	4	0.5	5	7	6	17	2.0	D
6.8	4	0.5	5	7	6	12	2.0	D
10	4	0.5	5	7	8	11	2.0	D
15	4	0.6	6	8	8	7	1.5	E
33	4	1.4	14	18	8	3	1.0	F
68	4	2.8	28	35	10	2	0.8	G
100	4	4.0	40	48	10	2	0.5	H
1.5	6	0.5	5	7	6	53	5.0	D
3.3	6	0.5	5	7	6	24	2.5	D
4.7	6	0.5	5	7	6	17	2.0	D
6.8	6	0.5	5	7	6	12	2.0	D
10	6	0.6	6	8	8	11	1.5	E
22	6	1.4	14	18	8	5	1.0	F
47	6	2.9	29	36	10	3	0.8	G
68	6	4.0	40	48	10	2	0.7	H
1.0	10	0.5	5	7	6	80	6.0	D
2.2	10	0.5	5	7	6	36	3.5	D
3.3	10	0.5	5	7	6	26	2.5	D
4.7	10	0.5	5	7	6	17	2.0	D
6.8	10	0.7	7	9	6	12	2.0	E
15	10	1.5	15	19	8	7	1.0	F
33	10	3.0	30	36	10	4	0.8	G
47	10	4.7	47	59	10	3	0.7	H
.68	15	0.5	5	7	6	120	8.0	D
1.5	15	0.5	5	7	6	53	5.0	D
2.2	15	0.5	5	7	6	36	3.5	D
3.3	15	0.5	5	7	6	24	2.5	D
4.7	15	0.8	8	10	6	17	2.5	E
10	15	1.5	15	19	6	8	1.5	F
22	15	3.3	33	42	8	5	1.0	G
33	15	5.0	50	60	8	3	0.8	H
.47	20	0.5	5	7	6	170	12.0	D
.68	20	0.5	5	7	6	120	8.0	D
1.0	20	0.5	5	7	6	80	8.0	D
1.5	20	0.5	5	7	6	53	5.0	D
2.2	20	0.5	5	7	6	36	3.5	D
3.3	20	0.7	7	9	6	24	3.0	E
6.8	20	1.4	14	18	6	12	2.5	F
15	20	3.0	30	36	6	6	1.0	G
22	20	4.0	40	48	6	4	1.0	H
.33	25	0.5	5	7	6	240	15.0	D
.68	25	0.5	5	7	6	120	10.0	D
1.0	25	0.5	5	7	6	80	8.0	D
1.5	25	0.5	5	7	6	53	5.0	D
2.2	25	0.6	6	8	6	36	3.5	E
4.7	25	1.2	12	15	6	17	2.5	F
6.8	25	1.7	17	22	6	12	2.0	G
10	25	2.5	25	32	6	8	1.5	G
15	25	3.8	38	48	6	6	1.0	H
.22	35	0.5	5	7	6	360	18.0	D
.47	35	0.5	5	7	6	170	10.0	D
.68	35	0.5	5	7	6	120	7.0	D
1.0	35	0.5	5	7	6	80	6.0	D
1.5	35	0.6	6	8	6	53	5.0	E
3.3	35	1.0	10	12	6	24	2.5	F
4.7	35	1.7	17	22	6	17	2.0	G
6.8	35	2.4	24	30	6	12	1.5	H
.47	50	0.5	5	7	6	170	8.0	D
.68	50	0.5	5	7	6	120	6.0	D
1.0	50	0.5	5	7	6	80	5.5	E
1.5	50	0.8	8	10	6	53	4.5	F
2.2	50	1.1	11	14	6	36	3.0	F
3.3	50	1.7	17	22	6	24	1.5	G
4.7	50	2.4	24	30	6	17	1.5	H

AC Power Dissipation

Case Code	Maximum Power Dissipation in Watts Ambient Temperature		
	25°C	85°C	125°C
D	.095	.085	.038
E	.100	.090	.040
F	.125	.112	.050
G	.150	.135	.060
H	.200	.180	.080

Major physical factors which limit the ability of the capacitor to dissipate internally generated heat produced during AC circuit operation, include unit construction features as related to a particular capacitor design, and heat transfer characteristics of the materials used in the construction of the capacitor. Larger volumetric packages exhibiting electrical characteristics similar to those of smaller physical packages will, under similar conditions, be capable of dissipating more power. Conformally coated capacitors, such as the STAR CHIP series, exhibit more efficient heat dissipation capabilities, due to the absence of relatively thick thermally insulative coatings, as incorporated in "molded" tantalum chip capacitor styles.

Maximum power dissipation levels shown represent an empirically determined wattage level required to cause a 10 degree centigrade temperature increase above the stated temperature in "still air" as measured on the external capacitor body, utilizing a thermo-couple or other appropriate measuring device.

AC Ripple Current

Circuit design and physical layout should provide "cool" circuit board locations for capacitors operating at high AC current levels. Capacitor temperature may increase due to heat transfer/absorption from the ambient environment or a "hot" component mounted in close proximity to the capacitor. The result of increased AC current is increased internal heat generation within the capacitor body. Waveform envelope is also a factor in the amount of internal heat generated within the capacitor since non-sinusoidal waveshapes produce heating effects different from those of sinusoidal waveforms.

The ripple current and voltage level impressed across the capacitor should not exceed the maximum power dissipation of the capacitor unless special provisions are made to increase the rate of heat dissipation from the body of the capacitor, such as by the use of a heat sink or providing air flow. Excessive power dissipation in tantalum chip capacitors may cause catastrophic failure. The I_{max} value of current must be used to determine the operating conditions.

The maximum permissible AC (rms) current applied across the capacitor is related to the equivalent series resistance (ESR) and the physical power dissipation capability of the capacitor. The maximum (rms) ripple current at a given frequency may be determined by:

$$I_{max}\ (rms) = \sqrt{Pdm/ESR}$$

where. . .Pdm = Maximum Power Dissipation in watts, at the maximum circuit operating temperature

$$ESR = \frac{1}{2\pi * \text{AC Frequency} * \text{Capacitance}} * \text{D.F.}$$

AC Frequency in Hertz
Capacitance is in Farads
Dissipation Factor is in decimal form

AC Ripple Voltage

The maximum AC ripple voltage at the applied frequency must be limited to an rms value which permits only the recommended maximum power dissipation specified for a given case code.

The maximum AC ripple voltage may be determined by:

$$E_r(rms) = Z\sqrt{Pdm/ESR}$$

where. . .E_r = AC Ripple Voltage
Z is the Impedance in ohms
Pdm is the Maximum Power Dissipation in watts, at the maximum circuit operating temperature
ESR is the Equivalent Series Resistance in ohms

Both voltage and current levels at a given frequency must be maintained so as not to exceed the recommended maximum power dissipation levels at the maximum circuit operating temperature. The DC bias voltage applied in series with the AC source applied across polar style capacitors, on which the AC voltage is "riding," may be ignored when considering the heating effects of AC current on the capacitor. The positive peak AC voltage plus the DC voltage must not exceed the rated DC voltage of the capacitor. The negative peak AC voltage in combination with the DC voltage may not obtain a level which will damage the dielectric due to reverse voltage being applied across a polar solid electrolyte tantalum chip capacitor.

Reverse Voltage

Series 49SC hybrid capacitor will withstand momentary voltage reversals up to 15% at 25°C, 10% at 55°C and 1% at 125°C of their rated voltage.

Marking

The small physical size of the STAR CHIP does not permit alpha-numeric marking on the body of the capacitor. Color dots on the body of the capacitor are available on special order, if required. Series 49SC capacitors are identified in their package container.

Polarity

Series 49SC capacitors are polar devices. Proper polarity must be observed or damage to the capacitor and/or the circuit will result. Polarity is marked with a dot or stripe on the positive (anode) end.

Non-Polar Operation

When two polar capacitors of the same DC voltage rating are connected back-to-back in non-polar configuration, i.e. positive-to-positive terminals or negative-to-negative terminals; the "non-polar" pair may be operated without DC bias voltage. If DC voltage is applied, the positive peak AC voltage plus the DC voltage must not exceed the rated voltage of the capacitor in either direction.

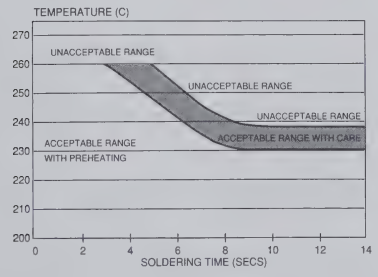
Surface-Mount Application

STAR CHIP capacitors are ideally suited for use on SMD circuit boards where circuit density requires the use of components with the highest cap/unit volume efficiency. Current solder reflow techniques such as IR (Infra-Red), Wave Soldering and Vapor Phase may be utilized with these capacitors.

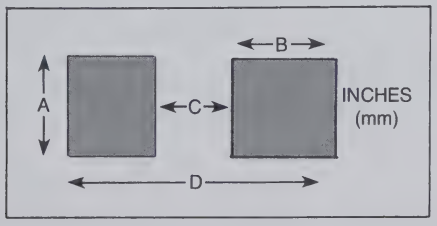
Soldering Profiles for Reflow

Soldering time and temperature should be kept to the minimum required for a good connection. Wave soldering can be very suitably performed at 230–250 degrees C over a period of 3–5 seconds. Infrared or vapor phase techniques should refer to the profile shown below. This profile ensures that the peak reflow and dwell time range does not allow the internal construction to exceed 220 degrees C. A maximum of 150 degrees C with a 10 minute dwell is recommended for the preheating profile. Slight parametric shifts in performance of the devices may be noted immediately following reflow. For this reason, it is recommended that a brief period of stabilization occur at ambient temperature prior to any electrical testing.

Recommended Reflow Time and Temperature

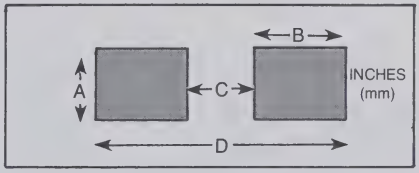


Recommended Pad Dimensions for Reflow Soldering



Case Size	A Min.	B Min.	C Nom.	D Nom.
D	.135 (3.42)	.062 (1.58)	.080 (2.04)	.254 (6.44)
E	.135 (3.42)	.062 (1.58)	.130 (3.31)	.304 (7.71)
F	.170 (4.31)	.062 (1.58)	.150 (3.82)	.324 (8.22)
G	.145 (3.67)	.082 (2.08)	.155 (3.94)	.369 (9.36)
H	.195 (4.94)	.082 (2.08)	.165 (4.20)	.379 (9.62)

Recommended Pad Dimensions for Wave Soldering



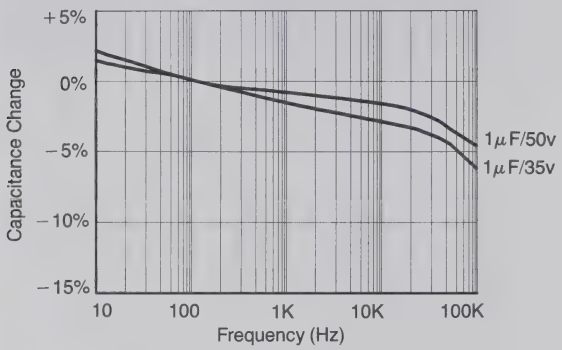
Case Size	A Min.	B Min.	C Nom.	D Nom.
D	.077 (1.96)	.067 (1.70)	.080 (2.04)	.254 (6.44)
E	.077 (1.96)	.067 (1.70)	.130 (3.31)	.304 (7.71)
F	.101 (2.55)	.067 (1.70)	.150 (3.81)	.324 (8.22)
G	.084 (2.13)	.087 (2.21)	.155 (3.94)	.369 (9.36)
H	.117 (2.98)	.087 (2.21)	.165 (4.20)	.379 (9.62)

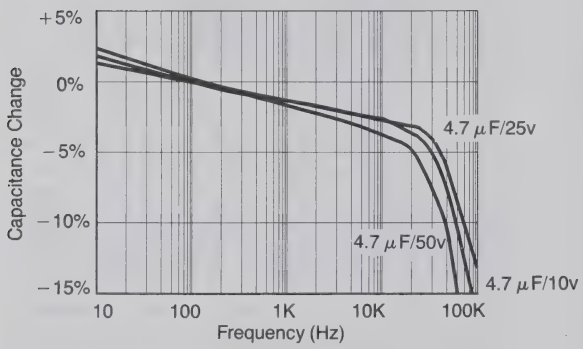
Additional Physical Statistics

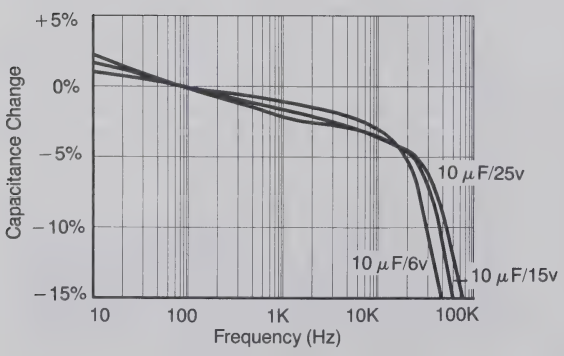
Case Code	Physical Statistics: Substrate sq. in.	Substrate sq. cm.	Typical Volume cu. in.	Typical Volume cu. cm.	Typical Weight (grams)
D	0.01500	0.0967	0.000750	0.0123	0.07
E	0.02000	0.1290	0.001000	0.0164	0.09
F	0.02970	0.1917	0.002079	0.0341	0.18
G	0.02915	0.1878	0.003200	0.0524	0.27
H	0.04400	0.2838	0.00484	0.0792	0.44

Typical Characteristics

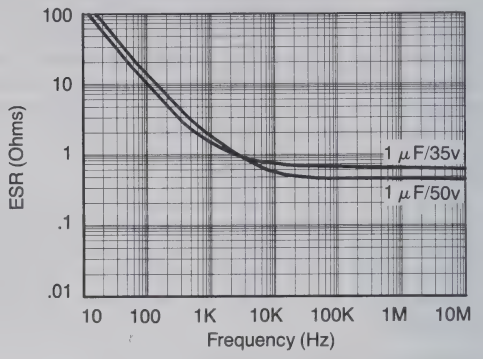
Capacitance Change with Frequency

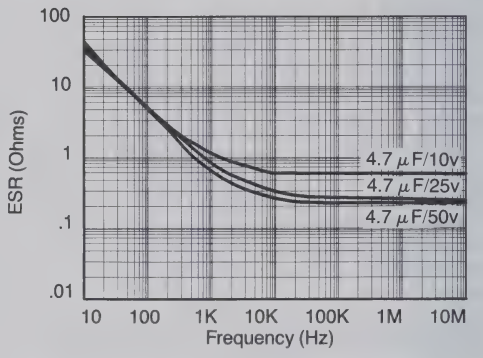


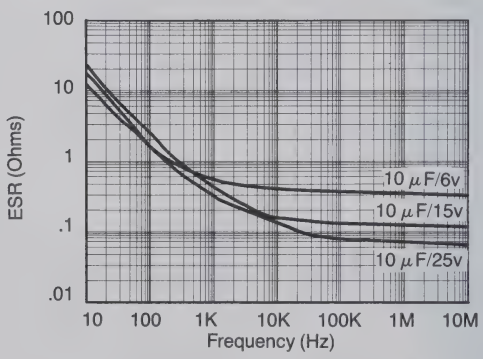


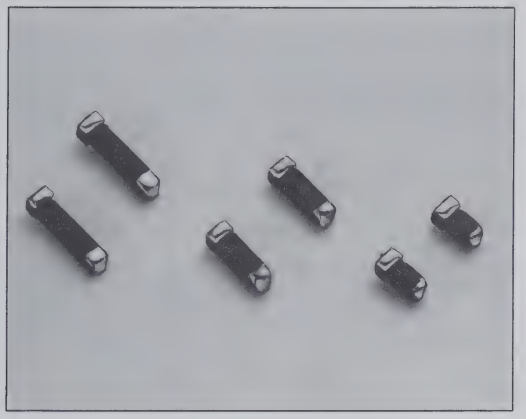


Equivalent Series Resistance vs Frequency









ULTRA CHIP Tantalum SMD® (Chip) Capacitors Series 49UC

Description

The 49UC ULTRA CHIP Series is a companion to the patented Philips Components BLUE CHIP, which has gained world-wide acceptance as the ultra high reliability capacitive component for military electronics and other sophisticated micro-electronic systems. It is a cost-effective alternative to the BLUE CHIP in high volume industrial applications.

The 49UC Series provides maximum volumetric efficiency in a conformally coated device. The capacitive element is protected from external contaminates by a proprietary conformal coating.

The ULTRA CHIP is available in three standard sizes which are physically similar to the BLUE CHIP and directly pad-compatible with MIL-C-55365/4 (CWR-06) style capacitors.

Philips Components 49UC series is especially suited for use on SMD circuit boards, as well as in thick or thin film hybrid circuits, where cap values between 0.1 μF and 6.8 μF are required.

ULTRA CHIP Surface Mount Devices are supplied in 8 and 12 mm embossed tape for efficiency in handling and storage as well as being compatible with all tape-fed high speed placement equipment.

Electrical characteristics such as low leakage current, and low equivalent series resistance and minimum capacitance shift at high frequencies make the ULTRA CHIP an excellent choice for circuits where actual performance must be weighed against low initial cost.

Philips Components manufactures the ULTRA CHIP products utilizing advanced Statistical Process Control methods (SPC). The use of Statistical Process Control techniques provides a very consistent and reliable product.

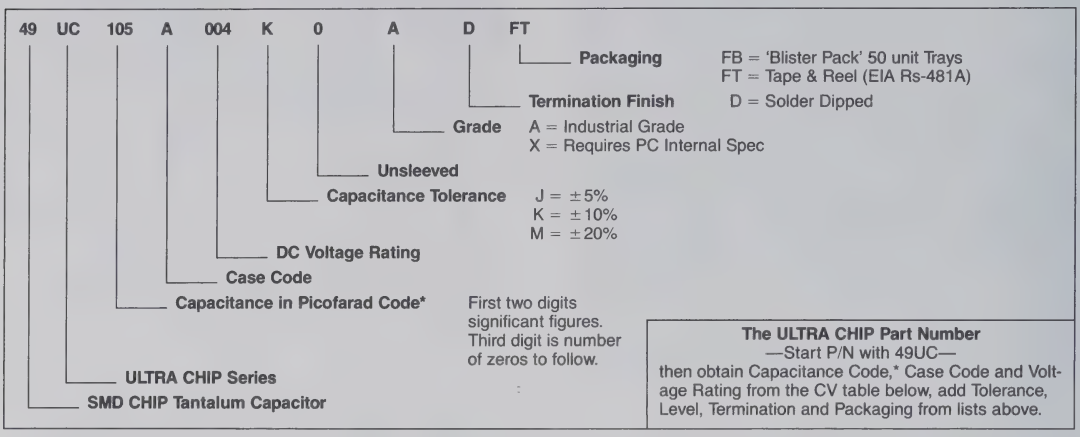
Features

- −55°C through +85°C Operation (125°C with Voltage Derating)
- Capacitance Range: 0.1 μF to 6.8 μF
- Rated Voltages: 4 VDC to 50 VDC
- Three Standard Case Sizes A, B, C (Pad-Compatible with CWR-06)
- Low Electrical losses and minimum capacitance shift in High-Frequency Applications
- Solder-Dipped Terminations Ideally Suited for Solder Reflow Techniques
- Conformally Coated Construction Provides Minimum Height as well as the Ultimate in Real Estate Efficiency
- Standard Tape & Reel Packaging

49UC is pad-compatible with CWR06 (MIL-C-55365/4) A, B, and C case sizes.

Part Number Designation

Philips Components Series 49UC ULTRA CHIP Capacitors can be completely specified using the following designation:


49 UC 105 A 004 K 0 A D FT
Packaging
FB = 'Blister Pack' 50 unit Trays
FT = Tape & Reel (EIA Rs-481A)
Termination Finish
D = Solder Dipped
Grade
A = Industrial Grade
X = Requires PC Internal Spec
Unsleeved
Capacitance Tolerance
J = ±5%
K = ±10%
M = ±20%
DC Voltage Rating
Case Code
Capacitance in Picofarad Code*
First two digits significant figures. Third digit is number of zeros to follow.
ULTRA CHIP Series
SMD CHIP Tantalum Capacitor
The ULTRA CHIP Part Number
—Start P/N with 49UC—
then obtain Capacitance Code,* Case Code and Voltage Rating from the CV table below, add Tolerance, Level, Termination and Packaging from lists above.

49UC Capacitance—Voltage—Case Code Table

Select standard Capacitance/Voltage ratings and corresponding standard ULTRA CHIP case codes from this table.

CAP μF	Picofarad Code*	004 V	006 V	010 V	015 V	020 V	025 V	035 V	050 V
0.10	104	A	A	A	A	A	A	A	A
0.15	154	A	A	A	A	A	A	A	A
0.22	224	A	A	A	A	A	A	A	B
0.33	334	A	A	A	A	A	A	B	B
0.47	474	A	A	A	A	A	B	B	C
0.68	684	A	A	A	A	B	B	C	
1.0	105	A	A	A	B	B	C		
1.5	155	A	A	B	B	C			
2.2	225	A	B	B	C				
3.3	335	B	B	C					
4.7	475	B	C						
6.8	685	C							

Physical Specifications

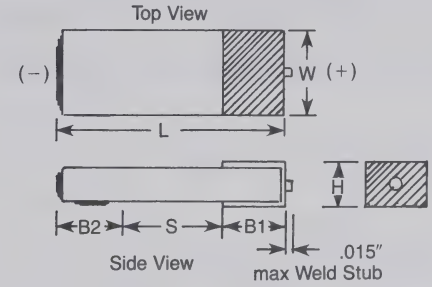
Dimensions—Inches

Case Code	(W) Width ±0.015	(L) Length ±0.015	(H) Height ±0.015	(S) Spacing Typical	(B1) + Pad Width ±0.010	(B2) − Pad Width −.010/ + .025
A	.050	.100	.050	.040	.030	.030
B	.050	.150	.050	.090	.030	.030
C	.050	.200	.050	.140	.030	.030

Dimensions—mm

Case Code	(W) Width ±0.015	(L) Length ±0.015	(H) Height ±0.015	(S) Spacing Typical	(B1) + Pad Width ±0.010	(B2) − Pad Width −.010/ + .025
A	1.27	2.54	1.27	1.02	0.76	0.76
B	1.27	3.81	1.27	2.29	0.76	0.76
C	1.27	5.08	1.27	3.55	0.76	0.76

Case Outline Drawing



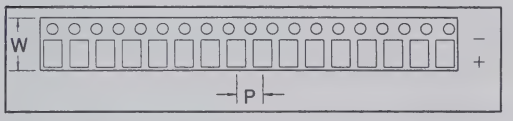
Notes:

1. For polarity identification, when chip is in mounting position, bare metal clip and weld stub are positive. The top negative surface is conformally coated.
2. Metric Equivalents are for general information purposes only and are based on 1″ = 25.4 mm.
3. Anode Riser (Weld Stub) may extend case size Length dimension by 0.015″ (.38 mm) max.
4. Spacing Dimension is typical distance between chip mounting terminations and therefore average distance between mounting pads on substrate.

Packaging

Tape & Reel

49UC Series capacitors are shipped in Tape & Reel packaging to facilitate the use of automatic placement equipment. Tape & Reel is per EIA (Electronic Industries Association) specification RS-481A. Capacitor orientation within tape pockets is negative terminal toward sprocket holes and mounting side down. 8 and 12 mm tape widths are used according to case size. Quantities less than minimum reel will be shipped in Blister Pack trays.

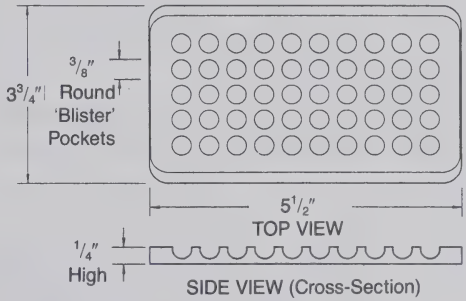


Tape & Reel Specifications

49UC Case Code	(W) Tape Width	(P) Unit Pitch Ctr/Ctr	Quantity per Full 7″ Reel	Minimum Quantity per Reel
A	8 mm	4 mm	3,000	1,500
B	12 mm	4 mm	3,000	1,500
C	12 mm	4 mm	3,000	1,500

Blister-Pack Trays

49UC Series capacitors are available in 'Blister Pack' trays containing 50 pieces each in a 5 × 10 matrix configuration. The Blister Pack provides a separate pocket for each unit to prevent damage to the capacitors during shipping, handling and storage.



Blister Pack trays are stamped polystyrene with a clear plastic cover. Orientation of the capacitors within the pockets is random with respect to polarity and mounting surface. This packaging is ideal for hand placement of the capacitors as it takes up very little room at a work station. It is recommended that operators remove and work with the ULTRA CHIPs using a blunt, coated tweezer to prevent damage to the conformal coating.

Application Notes

Capacitance

Capacitance shall be measured at or referred to 120 Hz at 25°C. The AC signal shall not exceed 1.0 VRMS.

Tolerance Type 49UC are available in ±20%, ±10% and ±5% capacitance tolerances.

Capacitance Change with Temperature from 25°C reading (maximum):

at −55°C −10% △
at +85°C +10% △
at +125°C +15% △

Dissipation Factor (DF)

DF is determined by the same method as capacitance.

DC Leakage Current (DCL)

DCL shall be measured at WVDC after a 5 minute electrification period with a 1000 ohm current-limiting resistor in series.

Voltage Rating

ULTRA CHIPS can be used at elevated temperatures when voltage is derated in accordance with the following:

Rated WVDC −55°C to 85°C	Derated (DC) 125°C	Surge Voltage (DC) 85°C	Surge Voltage (DC) 125°C
4	2.7	5.0	3.4
6	4.0	8.0	5.0
10	7.0	13.0	9.0
15	10.0	20.0	12.0
20	13.0	26.0	16.0
25	17.0	32.0	20.0
35	23.0	46.0	26.0
50	33.0	65.0	38.0

Surge Voltage

The surge voltage is the maximum DC voltage, including AC or other pulses applied for short duration.

Reverse Voltage

Series 49UC capacitors will withstand momentary voltage reversals up to 15% at 25°C, 10% at 55°C and 1% at 125°C of their rated voltage.

Electrical Limits & Case Codes

Cap. (nom) μF	Rated VDC 85°C	DC Leakage (max) 25°C μA	85°C μA	125°C μA	DF 120Hz %	ESR (max)* 120Hz Ω	100KHz Ω	Case Code
2.2	4	0.5	5	7	6	36	9.0	A
4.7	4	0.5	5	7	6	17	5.5	B
6.8	4	0.5	5	7	6	12	3.5	C
1.5	6	0.5	5	7	6	53	9.0	A
3.3	6	0.5	5	7	6	24	5.5	B
4.7	6	0.5	5	7	6	17	3.5	C
1.0	10	0.5	5	7	6	80	9.0	A
2.2	10	0.5	5	7	6	36	5.5	B
3.3	10	0.5	5	7	6	24	3.5	C
.68	15	0.5	5	7	6	120	10.0	A
1.5	15	0.5	5	7	6	53	6.0	B
2.2	15	0.5	5	7	6	36	4.0	C
.47	20	0.5	5	7	6	170	12.0	A
.68	20	0.5	5	7	6	120	8.0	B
1.0	20	0.5	5	7	6	80	8.0	B
1.5	20	0.5	5	7	6	53	6.0	C
.33	25	0.5	5	7	6	240	15.0	A
.68	25	0.5	5	7	6	120	10.0	B
1.0	25	0.5	5	7	6	80	8.0	C
.22	35	0.5	5	7	6	360	18.0	A
.47	35	0.5	5	7	6	170	12.0	B
.68	35	0.5	5	7	6	120	9.0	C
.10	50	0.5	5	7	6	800	20.0	A
.15	50	0.5	5	7	6	530	20.0	A
.22	50	0.5	5	7	6	360	15.0	B
.33	50	0.5	5	7	6	240	15.0	B
.47	50	0.5	5	7	6	170	10.0	C

*120 Hz ESR is maximum at nominal capacitance.

Marking

The small physical size of the ULTRA CHIP does not permit alpha-numeric marking on the body of the capacitor. Color dots on the body of the capacitor are available on special order, if required. Series 49UC capacitors are identified in their package container.

Polarity

Series 49UC capacitors are polar devices. Proper polarity must be observed or damage to the capacitor and/or the circuit will result.

AC Power Dissipation

Case Code	Maximum Power Dissipation in Watts Ambient Temperature		
	25°C	85°C	125°C
A	.063	.056	.025
B	.075	.067	.030
C	.081	.073	.032

Major physical factors which limit the ability of the capacitor to dissipate internally generated heat produced during AC circuit operation, include unit construction features as related to a particular capacitor design, and heat transfer characteristics of the materials used in the construction of the capacitor. Larger volumetric packages exhibiting electrical characteristics similar to those of smaller physical packages will, under similar conditions, be capable of dissipating more power. Conformally coated capacitors, such as the ULTRA CHIP series, exhibit more efficient heat dissipation capabilities, due to the absence of relatively thick thermally insulative coatings, as incorporated in "molded" tantalum chip capacitor styles.

Maximum power dissipation levels shown represent an empirically determined wattage level required to cause a 10 degree centigrade temperature increase above the stated temperature in "still air" as measured on the external capacitor body, utilizing a thermo-couple or other appropriate measuring device.

AC Ripple Current

Circuit design and physical layout should provide "cool" circuit board locations for capacitors operating at high AC current levels. Capacitor temperature may increase due to heat transfer/absorption from the ambient environment or a "hot" component mounted in close proximity to the capacitor. The result of increased AC current is increased internal heat generation within the capacitor body. Wave-form envelope is also a factor in the amount of internal heat generated within the capacitor since non-sinusoidal waveshapes produce heating effects different than those of sinusoidal waveforms.

The ripple current and voltage level impressed across the capacitor should not exceed the maximum power dissipation of the capacitor unless special provisions are made to increase the rate of heat dissipation from the body of the capacitor, such as by the use of a heat sink or providing air flow. Excessive power dissipation in tantalum chip capacitors may cause catastrophic failure. The I_{max} value of current must be used to determine the operating conditions.

The maximum permissible AC (rms) current applied across the capacitor is related to the equivalent series resistance (ESR) and the physical power dissipation capability of the capacitor. The maximum (rms) ripple current at a given frequency may be determined by:

$$I_{max}(rms) = \sqrt{Pdm/ESR}$$

where. . .Pdm = Maximum Power Dissipation in watts, at the maximum circuit operating temperature

$$ESR = \frac{1}{2\pi * \text{AC Frequency} * \text{Capacitance}} * D.F.$$

AC Frequency in Hertz
Capacitance is in Farads
Dissipation Factor is in decimal form

AC Ripple Voltage

The maximum AC ripple voltage at the applied frequency must be limited to an rms value which permits only the recommended maximum power dissipation specified for a given case code.

The maximum AC ripple voltage may be determined by:

$$E_r(rms) = Z\sqrt{Pdm/ESR}$$

where. . E_r = AC Ripple Voltage
Z is the Impedance in ohms
Pdm is the Maximum Power Dissipation in watts, at the maximum circuit operating temperature
ESR is the Equivalent Series Resistance in ohms

Both voltage and current levels at a given frequency must be maintained so as not to exceed the recommended maximum power dissipation levels at the maximum circuit operating temperature. The DC bias voltage applied in series with the AC source applied across polar style capacitors, on which the AC voltage is "riding," may be ignored when considering the heating effects of AC current on the capacitor. The positive peak AC voltage plus the DC voltage must not exceed the rated DC voltage of the capacitor. The negative peak AC voltage in combination with the DC voltage may not obtain a level which will damage the dielectric due to reverse voltage being applied across a polar solid electrolyte tantalum chip capacitor.

Non-Polar Operation

When two polar capacitors of the same DC voltage rating are connected back-to-back in non-polar configuration, i.e. positive-to-positive terminals or negative-to-negative terminals; the "non-polar" pair may be operated without DC bias voltage. If DC voltage is applied, the positive peak AC voltage plus the DC voltage must not exceed the rated voltage of the capacitor in either direction.

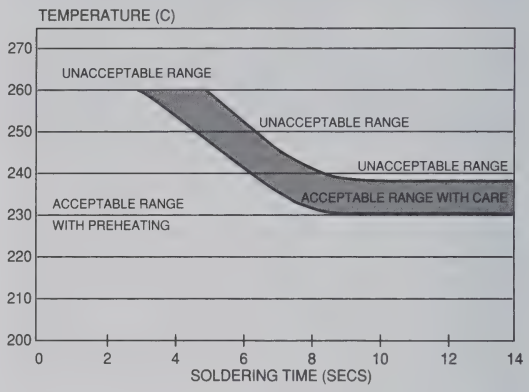
Surface-Mount Application

ULTRA CHIP capacitors are ideally suited for use on SMD circuit boards where circuit density requires the use of components with the highest cap/unit volume efficiency. Current solder reflow techniques such as IR (Infra-Red), Wave Soldering and Vapor Phase may be utilized with these capacitors.

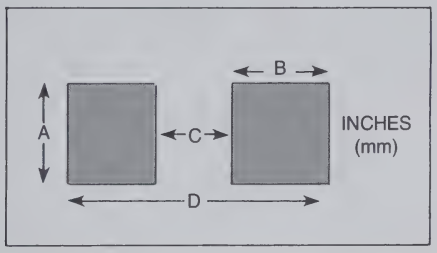
Soldering Profiles for Reflow

Soldering time and temperature should be kept to the minimum required for a good connection. Wave soldering can be very suitably performed at 230–250 degrees C over a period of 3–5 seconds. Infrared or vapor phase techniques should refer to the profile shown below. This profile ensures that the peak reflow and dwell time range does not allow the internal construction to exceed 220 degrees C. A maximum of 150 degrees C with a 10 minute dwell is recommended for the preheating profile. Slight parametric shifts in performance of the devices may be noted immediately following reflow. For this reason, it is recommended that a brief period of stabilization occur at ambient temperature prior to any electrical testing.

Recommended Reflow Time and Temperature

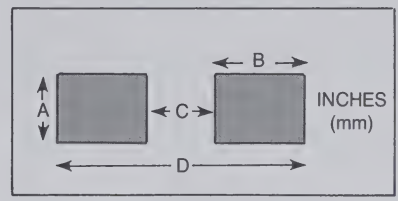


Recommended Pad Dimensions for Reflow Soldering



Case Size	A Min.	B Min.	C Nom.	D Nom.
A	.085 (2.15)	.062 (1.58)	.030 (0.77)	.204 (5.17)
B	.085 (2.15)	.062 (1.58)	.080 (2.04)	.254 (6.44)
C	.085 (2.15)	.062 (1.58)	.130 (3.31)	.304 (7.71)

Recommended Pad Dimensions for Wave Soldering

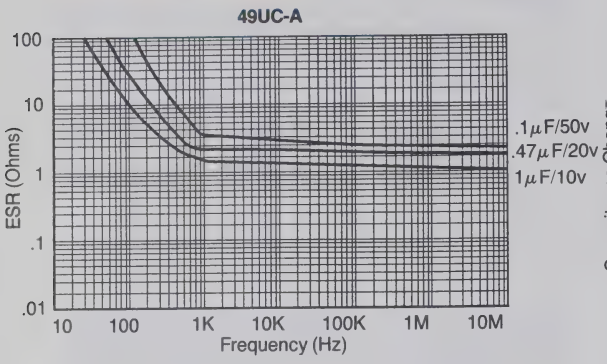


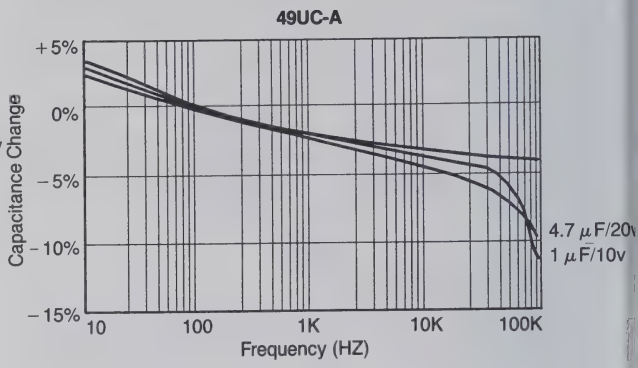
Case Size	A Min.	B Min.	C Nom.	D Nom.
A	.044 (1.11)	.067 (1.70)	.030 (0.77)	.204 (5.17)
B	.044 (1.11)	.067 (1.70)	.080 (2.04)	.254 (6.44)
C	.044 (1.11)	.067 (1.70)	.130 (3.31)	.304 (7.71)

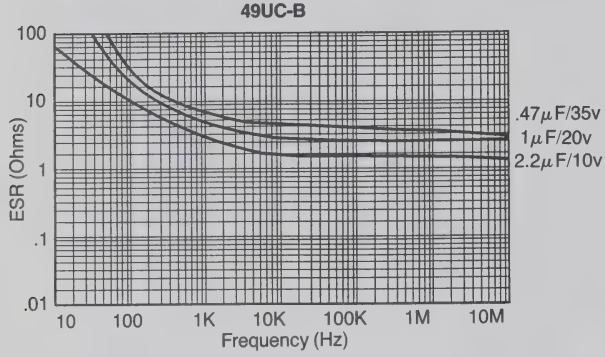
Additional Physical Statistics

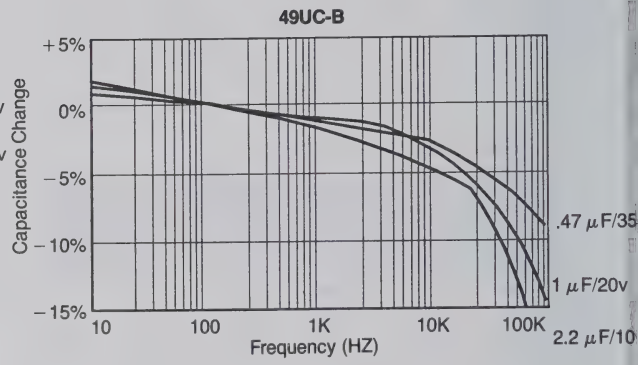
Case Code	Physical Statistics				Typical Weight (grams)
	Substrate		Typical Volume		
	sq. in.	sq. cm.	cu. in.	cu. cm.	
D	0.01500	0.0967	0.000750	0.0123	0.07
A	0.00500	0.0323	0.000250	0.0041	0.02
B	0.00750	0.0484	0.000375	0.0062	0.03
C	0.01000	0.0645	0.000500	0.0082	0.04

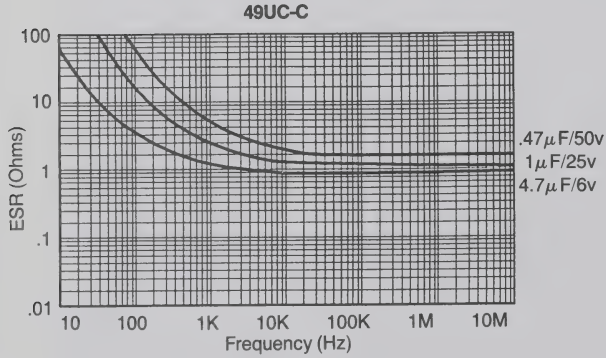
Typical Characteristics

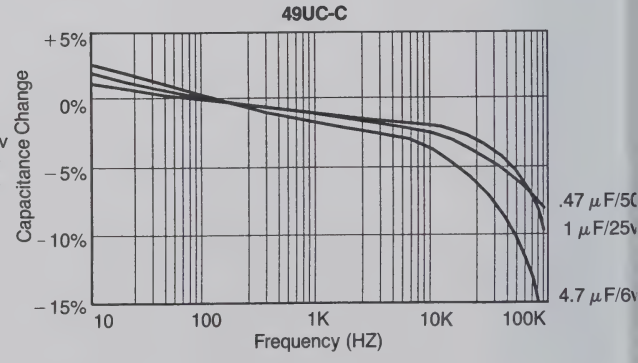


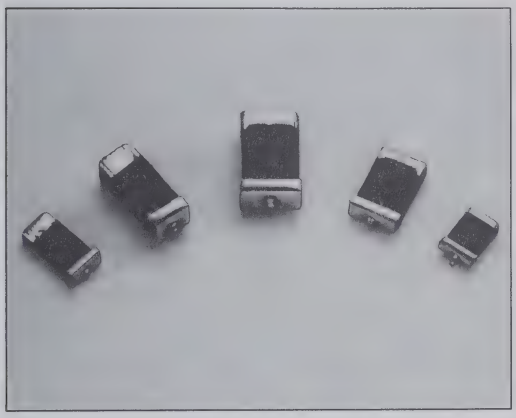












XTRA CHIP Tantalum SMD® (Chip) Capacitors Series 49XC

Description

The 49XC XTRA CHIP Series surface mounted tantalum chip capacitor offers the highest capacitance rating at a given rated voltage of any tantalum chip capacitor series currently available in the industry. . .a true "state-of-the-art" product.

The 49XC Series tantalum chip capacitor is the most volumetric efficient tantalum chip capacitor available for printed wiring board or thick/thin film hybrid circuit applications. The 49XC tantalum chip capacitor requires as little as 1/7 (one-seventh) the volume required by commercially available molded tantalum chip capacitor series, for comparable capacitance-voltage (CV) ratings. This advanced series offers up to 4 times the capacitance currently available in other conformally coated tantalum chip capacitors of the same voltage rating and size.

The XTRA CHIP tantalum chip capacitor is available in five standard case sizes which are identical to the STAR CHIP tantalum chip capacitor and cover the capacitance range of 1.0 μF through 220 μF in the voltage range of 4 through 50 VDC.

The capacitive element of each XTRA CHIP tantalum chip capacitor is protected by a "near-hermetic" patented construction feature which provides total compatibility with all standard soldering fluxes, soldering methods and cleaning solvents. This construction also provides efficient ripple current heat dissipation in each of the five case sizes.

XTRA CHIP Surface Mount Devices are supplied in 12 mm embossed tape for efficiency in handling and storage. This packaging conforms to EIA standard RS-481 and is compatible with all tape-fed high speed placement equipment cost.

Philips Components utilizes modern automated manufacturing processes incorporating Statistical Process Control (SPC) methods interacting with an integrated Manufacturing Resources Planning (MRP II) system to manufacture a very consistent and reliable product.

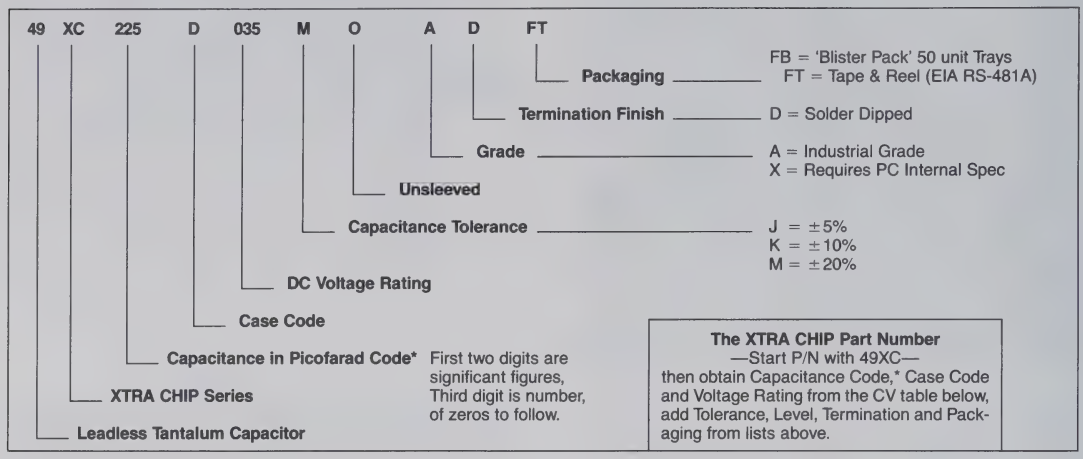
Features

- −55°C through +85°C Operation (125°C with Voltage Derating)
- Capacitance Range: 1.0 μF to 220 μF
- Rated Voltages: 4 VDC to 50 VDC
- Five Standard Case Sizes: D, E, F, G, H
- Low ESR in High-Frequency Applications
- Solder-Dipped Terminations Ideally Suited for Solder Reflow Techniques
- Conformally Coated Construction Provides Minimum Height
- 12 mm Tape & Reel (Standard Packaging) Conforms to EIA RS-481 Specifications

®SMD is a Service Mark of North American Philips Corporation
The XTRA CHIP is covered by US Patent No. 4,571,664

Part Number Designation

Philips Components Series 49XC XTRA CHIP Capacitors can be completely specified using the following designation:


49 XC 225 D 035 M O A D FT
Packaging
FB = 'Blister Pack' 50 unit Trays
FT = Tape & Reel (EIA RS-481A)
Termination Finish
D = Solder Dipped
Grade
A = Industrial Grade
X = Requires PC Internal Spec
Unsleeved
Capacitance Tolerance
J = ±5%
K = ±10%
M = ±20%
DC Voltage Rating
Case Code
Capacitance in Picofarad Code*
First two digits are significant figures, Third digit is number, of zeros to follow.
XTRA CHIP Series
Leadless Tantalum Capacitor
The XTRA CHIP Part Number
—Start P/N with 49XC—
then obtain Capacitance Code,* Case Code and Voltage Rating from the CV table below, add Tolerance, Level, Termination and Packaging from lists above.

49XC Capacitance—Voltage—Case Code Table

Select standard Capacitance-Voltage ratings and corresponding standard XTRA CHIP case codes from this table.

CAP μF	Picofarad Code*	004 V	006 V	010 V	015 V	020 V	025 V	035 V	050 V
1.0	105	→	→	→	→	→	→	→	D
1.5	155	→	→	→	→	→	→	D	D
2.2	225	→	→	→	→	→	→	D	E
3.3	335	→	→	→	→	→	D	E	F
4.7	475	→	→	→	→	→	D	F	G
6.8	685	→	→	→	→	D	E	F	G
10	106	→	→	→	D	E	F	G	H
15	156	→	→	→	D	→	F	H	
22	226	→	→	D	→	F	G		
33	336	→	D	→	F	G	H		
47	476	→	E	F	G	H			
68	686	→	F	G	H				
100	107	F	G	H					
120	127	→	G	H					
150	157	→	G						
180	187	G	H						
220	227	H							

Arrow indicates that next higher voltage is the standard rating available.

Physical Specifications

Dimensions—Inches

Case Code	(W) Width ±0.015	(L) Length ±0.015	(H) Height ±0.015	(S) Spacing Typical	(B1) +Pad Width ±0.010	(B2) −Pad Width −.010/+.025
D	.100	.160	.060	.100	.030	.030
E	.100	.210	.060	.150	.030	.030
F	.135	.230	.075	.170	.030	.030
G	.110	.265	.110	.165	.050	.050
H	.160	.275	.110	.175	.050	.050

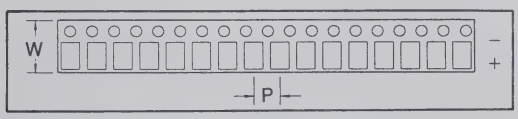
Dimensions—mm

Case Code	(W) Width ±0.381	(L) Length ±0.381	(H) Height ±0.381	(S) Spacing Typical	(B1) +Pad Width ±0.254	(B2) −Pad Width −.254/+.635
D	2.54	4.06	1.52	2.54	0.76	0.76
E	2.54	5.33	1.52	3.81	0.76	0.76
F	3.43	5.84	1.90	4.32	0.76	0.76
G	2.79	6.73	2.79	4.19	1.27	1.27
H	4.06	6.99	2.79	4.45	1.27	1.27

Packaging

Tape & Reel

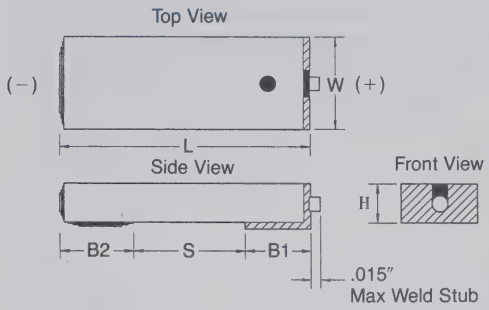
XTRA CHIP Series capacitors are shipped in Tape & Reel packaging to facilitate the use of automatic placement equipment. Tape & Reel is per EIA (Electronic Industries Association) specification RS 481. Orientation of the chip within the tape pockets is negative terminal toward sprocket holes and mounting side down. Quantities less than minimum reel will be shipped in Blister-Pack trays.



Tape & Reel Specifications

Case Code	(W) Tape Width	(P) Unit Pitch Ctr/Ctr	Quantity per full 7″ Reel	Minimum Quantity per Reel
D	12mm	4mm	2,700	1,350
E	12mm	4mm	2,700	1,350
F	12mm	8mm	1,000	500
G	12mm	8mm	700	350
H	12mm	8mm	700	350

Case Outline Drawing

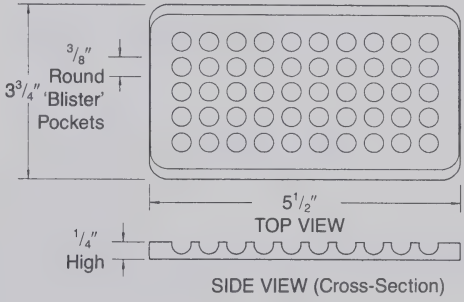


Notes:

1. For polarity identification, when chip is in mounting position, metal "L" clip and weld stub are positive. The top negative surface is conformally coated.
2. Metric equivalents are for general information purposes only and are based on 1″ = 25.4 mm.
3. Anode riser (Weld Stub) may extend case size Length dimension by 0.015″ (.38 mm) max.
4. Spacing dimension is typical distance between chip mounting terminations and therefore average distance between mounting pads on substrate.

Blister-Pack Trays

49XC Series capacitors are available in Blister Pack trays containing 50 pieces each in a 5 × 10 matrix configuration. Blister Pack trays are stamped polystyrene with a clear plastic cover.



Orientation of the capacitors within the tray pockets is random with respect to polarity and mounting surface. This packaging is ideal for hand placement of the capacitors as it takes up very little room at the workstation.

Application Notes

Capacitance

Capacitance shall be measured at or referred to 120 Hz at 25°C. The AC signal shall not exceed 1.0 VRMS.

- TOLERANCE: ±20%, ±10% and ±5% cap tolerances are available.
- Max capacitance change with temperature from 25°C

Temperature	−55°C	+85°C	+125°C
Max. Cap Change	−10% △	+10% △	+15% △

Dissipation Factor (DF)

DF is determined by the same method as capacitance.

DC Leakage Current (DCL)

DCL shall be measured at WVDC after a 5 minute electrification period with a 1000 ohm current-limiting resistor in series.

Voltage Rating

All XTRA CHIP tantalum chip capacitors can be used at elevated temperatures when the working voltage is derated in accordance with the following table.

Rated WVDC −55°C to +85°C	Derated (DC) +125°C	Surge Voltage (DC) +85°C	Surge Voltage (DC) +125°C
4	2.7	5.0	3.4
6	4.0	8.0	5.0
10	7.0	13.0	9.0
15	10.0	20.0	12.0
20	13.0	26.0	16.0
25	17.0	32.0	20.0
35	23.0	46.0	26.0
50	33.0	65.0	38.0

XTRA CHIP Electrical Limits & Case Codes

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	Dissipation Factor 25°C %	85°C 125°C	−55°C %	$ESR_{(max)}$ 100KHz Ω	Case Code
100	4	4.0	40	48	10	12	12	0.5	F
180	4	8.0	80	96	10	12	12	0.5	G
220	4	9.0	90	108	10	12	12	0.5	H
33	6	2.0	20	24	10	12	12	1.0	D
47	6	3.0	30	36	10	12	12	0.8	E
68	6	4.0	40	48	10	12	12	0.7	F
100	6	6.0	60	72	10	12	12	0.5	G
120	6	8.0	80	96	10	12	12	0.5	G
150	6	9.0	90	108	10	12	12	0.5	G
180	6	11.0	110	132	10	12	12	0.5	H
22	10	3.0	30	36	10	12	12	1.0	D
47	10	5.0	50	60	10	12	12	0.7	F
68	10	7.0	70	84	10	12	12	0.7	G
100	10	10.0	100	120	10	12	12	0.5	H
120	10	12.0	120	144	10	12	12	0.5	H
10	15	2.0	20	24	6	8	8	1.5	D
15	15	3.0	30	36	6	8	8	1.5	D
33	15	5.0	50	60	6	8	8	0.8	F
47	15	8.0	80	96	6	8	8	0.8	G
68	15	11.0	110	132	6	8	8	0.8	H
6.8	20	2.0	20	24	6	8	8	2.5	D
10	20	2.0	20	24	6	8	8	2.5	E
22	20	2.0	50	60	6	8	8	1.0	F

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	Dissipation Factor 25°C %	85°C 125°C	−55°C %	$ESR_{(max)}$ 100KHz Ω	Case Code
33	20	7.0	70	84	6	8	8	1.0	G
47	20	10.0	100	120	6	8	8	1.0	H
3.3	25	1.0	10	12	6	8	8	3.5	D
4.7	25	2.0	20	24	6	8	8	2.5	D
6.8	25	2.0	20	24	6	8	8	2.0	E
10	25	3.0	30	36	6	8	8	2.0	F
15	25	4.0	40	48	6	8	8	1.0	F
22	25	6.0	60	72	6	8	8	1.0	G
33	25	9.0	90	108	6	8	8	1.0	H
1.0	35	1.0	10	12	6	8	8	6.0	D
1.5	35	1.0	10	12	6	8	8	5.0	D
2.2	35	1.0	10	12	6	8	8	3.5	D
3.3	35	2.0	20	24	6	8	8	2.5	E
4.7	35	2.0	20	24	6	8	8	2.5	F
6.8	35	3.0	30	36	6	8	8	2.0	F
10	35	4.0	40	48	6	8	8	2.0	G
15	35	6.0	60	72	6	8	8	2.0	H
1.0	50	1.0	10	12	6	8	8	6.0	D
1.5	50	1.0	10	12	6	8	8	5.0	D
2.2	50	2.0	20	24	6	8	8	3.5	E
3.3	50	2.0	20	24	6	8	8	2.5	F
4.7	50	3.0	30	36	6	8	8	2.5	G
6.8	50	4.0	40	48	6	8	8	2.5	G
10	50	5.0	50	60	6	8	8	2.5	H

Application Notes

AC Power Dissipation

Case Code	Maximum Power Dissipation in Watts Ambient Temperature		
	+25°C	+85°C	+125°C
D	.095	.085	.038
E	.100	.090	.040
F	.125	.112	.050
G	.150	.135	.060
H	.200	.180	.080

Major physical factors which limit the ability of the capacitor to dissipate internally generated heat produced during AC circuit operation, include unit construction features as related to a particular capacitor design, and heat transfer characteristics of the materials used in the construction of the capacitor. Larger volumetric packages exhibiting electrical characteristics similar to those of smaller physical packages will, under similar conditions, be capable of dissipating more power. Conformally coated capacitors, such as the XTRA CHIP series tantalum chip capacitor, exhibit more efficient heat dissipation capabilities, due to the absence of relatively thick thermally insulative coatings, as incorporated in "molded" tantalum chip capacitor styles.

Maximum power dissipation levels shown represent an empirically determined wattage level required to cause a 10 degree centigrade temperature increase above the stated temperature in "still air" as measured on the external capacitor body, utilizing a thermo-couple or other appropriate measuring device.

AC Ripple Current

Circuit design and physical layout should provide "cool" circuit board locations for capacitors operating at high AC current levels. Capacitor temperature may increase due to heat transfer or absorption from the ambient environment or a "hot" component mounted in close proximity to the capacitor. The result of increased AC current is increased internal heat generation within the capacitor body. Waveform envelope is also a factor in the amount of internal heat generated within the capacitor since non-sinusoidal waveshapes produce heating effects different than those of sinusoidal waveforms.

The ripple current and voltage level impressed across the capacitor should not exceed the maximum power dissipation of the capacitor unless special provisions are made to increase the rate of heat dissipation from the body of the capacitor, such as by the use of a heat sink or providing air flow. Excessive power dissipation in tantalum chip capacitors may cause catastrophic failure. The I_{max} value of current must be used to determine the operating conditions.

The maximum permissible AC (rms) current applied across the capacitor is related to the equivalent series resistance (ESR) and the physical power dissipation capability of the capacitor. The maximum (rms) ripple current at a given frequency may be determined by:

$$I_{max}(rms) = \sqrt{Pdm/ESR}$$

where. . .Pdm = Maximum Power Dissipation in watts, at the maximum circuit operating temperature

$$ESR = \frac{D.F.}{2\pi * \text{AC Frequency} * \text{Capacitance}}$$

AC Frequency is in Hertz
Capacitance is in Farads
Dissipation Factor is in decimal form

AC Ripple Voltage

The maximum AC ripple voltage at the applied frequency must be limited to an rms value which permits only the recommended maximum power dissipation specified for a given case code. The maximum AC ripple voltage may be determined by:

$$E_r(rms) = \sqrt{Pdm/ESR}$$

where. . .E_r = AC Ripple Voltage
Z is the Impedance in ohms
Pdm is the Maximum Power Dissipation in watts, at the maximum circuit operating temperature
ESR is the Equivalent Series Resistance in ohms

Both voltage and current levels at a given frequency must be maintained so as not to exceed the recommended maximum power dissipation levels at the maximum circuit operating temperature. The DC bias voltage applied in series with the AC source applied across polar style capacitors, on which the AC voltage is "riding," may be ignored when considering the heating effects of AC current on the capacitor. The positive peak AC voltage plus the DC voltage must not exceed the rated DC voltage of the capacitor. The negative peak AC voltage in combination with the DC voltage may not obtain a level which will damage the dielectric due to reverse voltage being applied across a polar solid electrolyte tantalum chip capacitor.

Surge Voltage

The surge voltage is the maximum DC voltage, including AC or other pulses applied for short duration.

Reverse Voltage

Series 49XC hybrid capacitor will withstand momentary voltage reversals up to 15% at 25°C, 10% at 55°C and 1% at 125°C of the capacitor's rated voltage.

Polarity

Series 49XC capacitors are polar devices. Proper polarity must be observed or damage to the capacitor and/or the circuit will result. The positive end is marked with a dot or stripe.

Application Notes

Marking

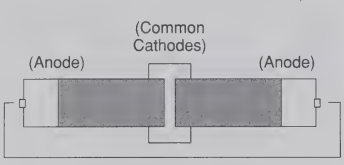
The small physical size of the XTRA CHIP capacitor does not permit alpha-numeric marking on the body of the capacitor. Color dots on the body of the capacitor are available on special order, if required. Series 49XC capacitors are identified on their package container.

Non-Polar Operation

When two polar capacitors of the same DC voltage rating are connected back-to-back in non-polar configuration, i.e. positive-to-positive terminals or negative-to-negative terminals; the "non-polar" pair may be operated without DC bias voltage. If DC voltage is applied, the positive peak AC voltage plus the DC voltage must not exceed the rated voltage of the capacitor in either direction. In circuits where voltage reversals exceeding 15% at 25°C occur, or where AC ripple voltages are high, XTRA CHIP capacitors should be mounted in a non-polar configuration.

In these cases, if two identical XTRA CHIP capacitors are mounted in this fashion, the resulting capacitance will be 1/2 the value of the original devices and the voltage will be the same as the rating of the original devices.

Non-Polar Operation
Voltage dropped across anodes of capacitors in non-polar configuration (cathodes tied together)



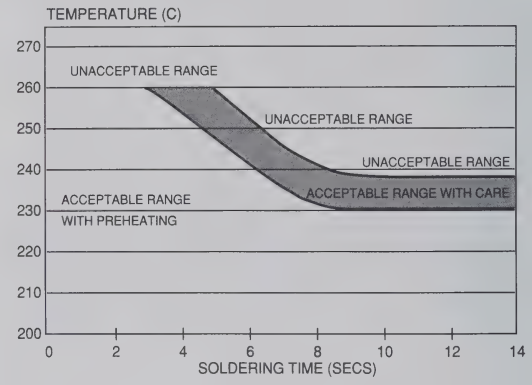
Surface-Mount Application

XTRA CHIP capacitors are ideally suited for use on SMD circuit boards where circuit density requires the use of components with the highest cap/unit volume efficiency. Current solder reflow techniques such as IR (Infra-Red), Wave Soldering and Vapor Phase may be utilized with these capacitors.

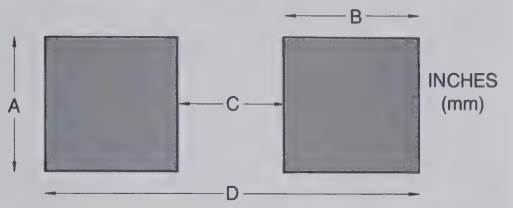
Soldering Profiles for Reflow

Soldering time and temperature should be kept to the minimum required for a good connection. Wave soldering can be very suitably performed at 230–250 degrees C over a period of 3–5 seconds. Infrared or vapor phase techniques should refer to the profile shown below. This profile ensures that the peak reflow and dwell time range does not allow the internal construction to exceed 220 degrees C. A maximum of 150 degrees C with a 10 minute dwell is recommended for the preheating profile. Slight parametric shifts in performance of the devices may be noted immediately following reflow. For this reason, it is recommended that a brief period of stabilization occur at ambient temperature prior to any electrical testing.

Recommended Reflow Time and Temperature

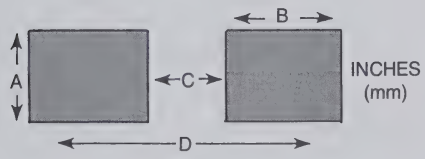


Recommended Pad Dimensions for Reflow Soldering



Case Size	A Min.	B Min.	C Nom.	D Nom.
D	.135 (3.42)	.062 (1.58)	.080 (2.04)	.254 (6.44)
E	.135 (3.42)	.062 (1.58)	.130 (3.31)	.304 (7.71)
F	.170 (4.31)	.062 (1.58)	.150 (3.82)	.324 (8.22)
G	.145 (3.67)	.082 (2.08)	.155 (3.94)	.369 (9.36)
H	.195 (4.94)	.082 (2.08)	.165 (4.20)	.379 (9.62)

Recommended Pad Dimensions for Wave Soldering



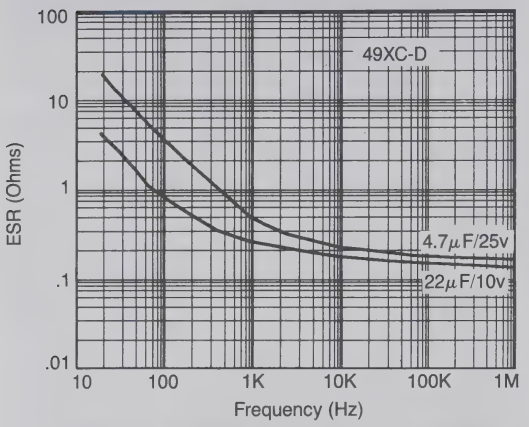
Case Size	A Min.	B Min.	C Nom.	D Nom.
D	.077 (1.196)	.067 (1.70)	.080 (2.04)	.254 (6.44)
E	.077 (1.96)	.067 (1.70)	.130 (3.31)	.304 (7.71)
F	.101 (2.55)	.067 (1.70)	.150 (3.81)	.324 (8.22)
G	.084 (2.13)	.087 (2.21)	.155 (3.94)	.369 (9.36)
H	.117 (2.98)	.087 (2.21)	.165 (4.20)	.379 (9.62)

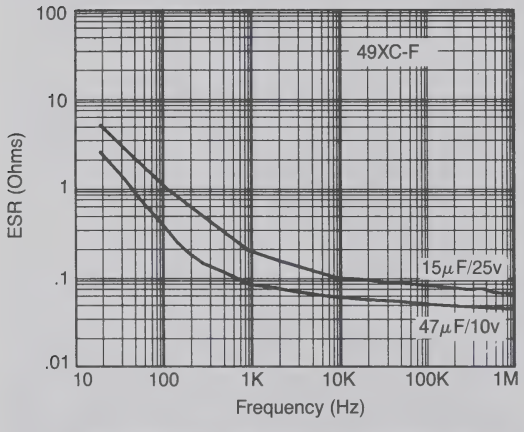
Additional Physical Statistics

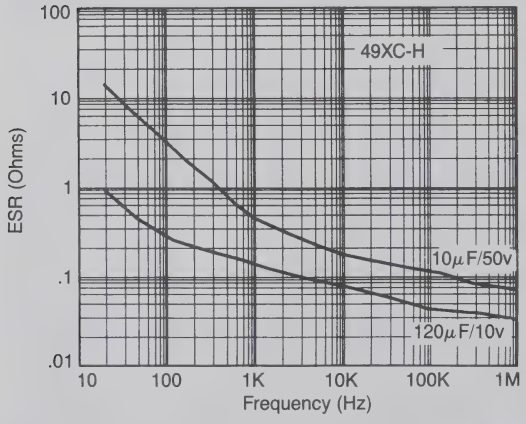
Physical Statistics					Typical Weight (grams)
Case Code	Substrate Area sq. in.	sq. cm.	Typical Volume cu in.	cu. cm.	
D	0.01500	0.0967	0.000750	0.0123	0.07
E	0.02000	0.1290	0.001000	0.0164	0.09
F	0.02970	0.1917	0.002079	0.0341	0.18
G	0.02915	0.1878	0.003200	0.0524	0.27
H	0.04560	0.2944	0.005060	0.0821	0.44

Applications Guidelines

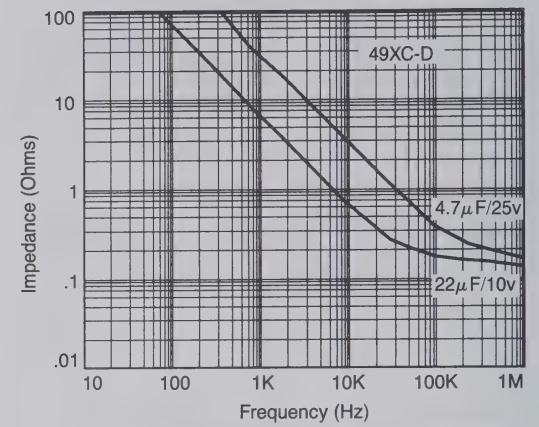
Equivalent Series Resistance vs Frequency

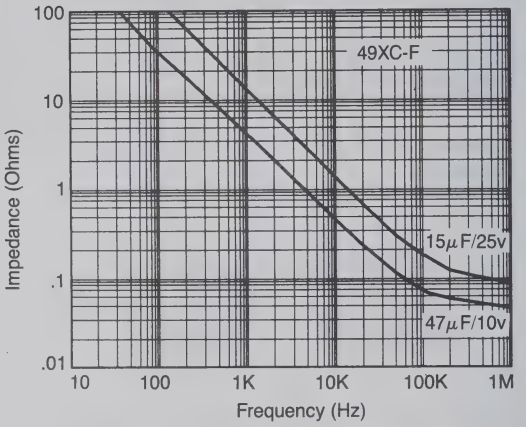


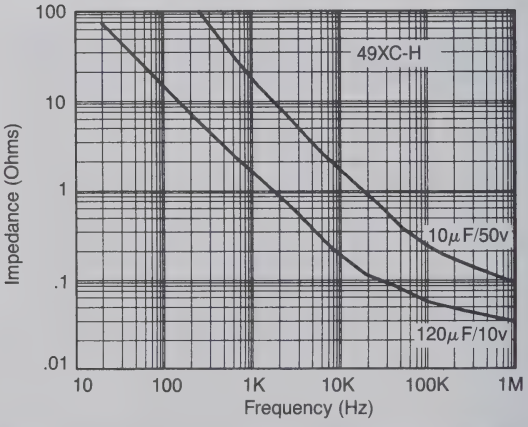


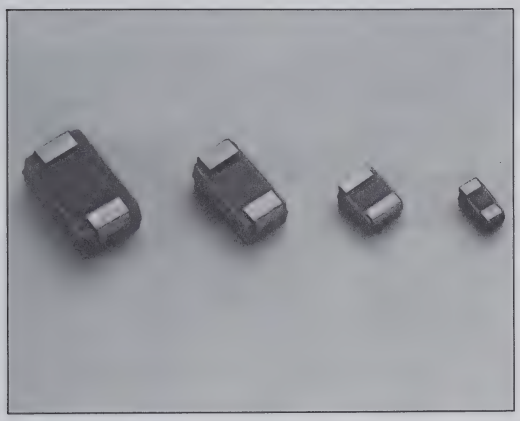


Impedance vs Frequency









MOLDED CHIP Tantalum SMD® (Chip) Capacitors Series 49MC

Description

The 49MC is a molded chip capacitor designed specifically for high volume surface mount applications where handling with high-speed pick and place equipment is required.

The MOLDED CHIP construction protects the internal capacitor element from external contaminants and is totally compatible with the standard reflow soldering and cleaning methods encountered during SMT manufacturing.

The 49MC series product is available in four standard case sizes which conform to the EIA/U.S. Manufacturer's Standard for Tantalum Chip Capacitors.

The Philips MOLDED CHIP is ideally suited for use on circuit boards where cap values between 0.1 μF and 100 μF are required.

The molded construction provides total uniformity of size and flat surfaces required for automatic chip placement.

The MOLDED CHIP is also available in the military established reliability MIL-C-55365/8 Style CWR11 for use in military SMT electronic circuit designs. The CWR11 style MOLDED CHIP is available in both Exponential Failure Rate Levels (M and P) and Weibull Graded Failure Rate Levels (B, C, and D).

Philips utilizes the most modern manufacturing processes coupled with Statistical Process Control methods (SPC) and an integrated Manufacturing Resources Planning system (MRP II) to provide a very consistent and reliable product for either small or large volume usages.

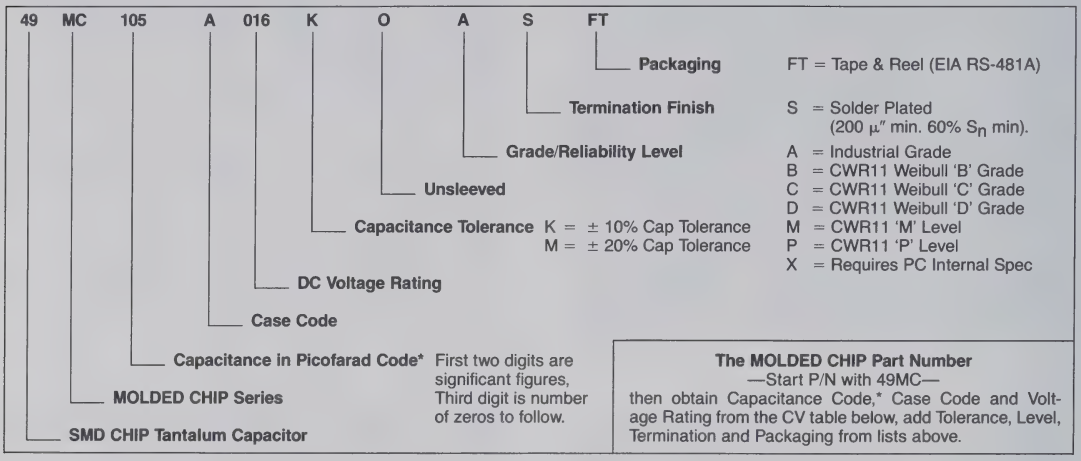
Features

- 4 Standard Physical Case Sizes which conform to the EIA/U.S. Manufacturer's Standard EIA-535BAAC for Tantalum Chip Capacitors (formerly EIA IS-28)
- −55°C through +85°C Operation (125°C with Voltage Derating)
- Capacitance Range: 0.1 μF to 100 μF
- Rated Voltages: 4 VDC to 50 VDC
- Qualification to MIL-C-55365/8 Style CWR11 Exponential Failure Rate Levels (M and P) and Weibull Graded Failure Rate Levels (B, C, and D).
- Standard Electro-Plated Tin/Lead Terminations are suited for most Solder Reflow applications
- Tape & Reel Packaging per EIA Specification RS-481

*SMD is a Service Mark of North American Philips Corporation

Part Number Designation

Philips Components Series 49MC Molded Chip Capacitors can be completely specified using the following designation:


49 MC 105 A 016 K O A S FT
SMD CHIP Tantalum Capacitor
MOLDED CHIP Series
Capacitance in Picofarad Code* First two digits are significant figures, Third digit is number of zeros to follow.
Case Code
DC Voltage Rating
Capacitance Tolerance K = ± 10% Cap Tolerance M = ± 20% Cap Tolerance
Unsleeved
Grade/Reliability Level
Termination Finish
Packaging
FT = Tape & Reel (EIA RS-481A)
S = Solder Plated (200 μ" min. 60% Sn min).
A = Industrial Grade
B = CWR11 Weibull 'B' Grade
C = CWR11 Weibull 'C' Grade
D = CWR11 Weibull 'D' Grade
M = CWR11 'M' Level
P = CWR11 'P' Level
X = Requires PC Internal Spec
The MOLDED CHIP Part Number
—Start P/N with 49MC—
then obtain Capacitance Code,* Case Code and Voltage Rating from the CV table below, add Tolerance, Level, Termination and Packaging from lists above.

Physical Specifications

Dimensions—Inches

Case Code		(L)	(W)	(H)	(B)	(S)	Tab Dimensions	
EIA	49MC	Length	Width	Height	Pad Width	Min	(W2) Min-Max	(H2)
3216	A	.126 ± .008	.063 ± .008	.063 ± .008	.031 ± .012	.031	.043-.051	.028 min
3528	B	.138 ± .008	.110 ± .008	.075 ± .008	.031 ± .012	.043	.083-.091	.028 min
6032	C	.236 ± .012	.126 ± .012	.098 ± .012	.051 ± .012	.098	.083-.091	.039 min
7343	D	.287 ± .012	.169 ± .012	.110 ± .012	.051 ± .012	.149	.091-.098	.039 min

Dimensions—mm

Case Code		(L)	(W)	(H)	(B)	(S)	Tab Dimensions	
EIA	49MC	Length	Width	Height	Pad Width	Min	(W2) Min-Max	(H2)
3216	A	3.2 ± 0.2	1.6 ± 0.2	1.6 ± 0.2	0.8 ± 0.3	0.8	1.1-1.3	0.7 min
3528	B	3.5 ± 0.2	2.8 ± 0.2	1.9 ± 0.2	0.8 ± 0.3	1.1	2.1-2.3	0.7 min
6032	C	6.0 ± 0.3	3.2 ± 0.3	2.5 ± 0.3	1.3 ± 0.3	2.5	2.1-2.3	1.0 min
7343	D	7.3 ± 0.3	4.3 ± 0.3	2.8 ± 0.3	1.3 ± 0.3	3.8	2.3-2.5	1.0 min

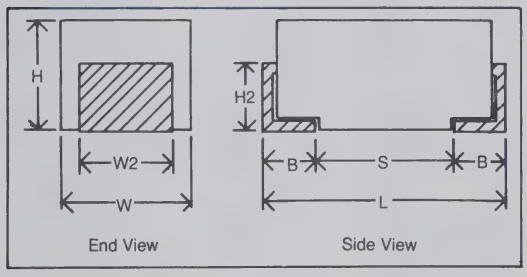
49MC Capacitance—Voltage—Case Code Table

Select standard Capacitance/Voltage ratings and corresponding standard Molded Chip case codes from this table.

CAP μF	Picofarad Code	004 V	006 V	010 V	016 V	020 V	025 V	035 V	050 V
0.10	104	→	→	→	→	→	→	A	A
0.15	154	→	→	→	→	→	→	A	B
0.22	224	→	→	→	→	→	→	A	B
0.33	334	→	→	→	→	→	→	A	B
0.47	474	→	→	→	→	→	A	B	C
0.68	684	→	→	→	→	A	→	B	C
1.0	105	→	→	→	A	A	→	B	C
1.5	155	→	→	A	A	→	B	C	D
2.2	225	→	A	A	→	B	→	C	D
3.3	335	A	A	→	B	B	C	C	D
4.7	475	A	→	B	B	C	C	D	D
6.8	685	→	B	B	C	C	D	D	
10.0	106	B	B	C	C	→	D	D	
15.0	156	B	C	C	→	D	D		
22.0	226	C	C	→	D	D			
33.0	336	C	→	D	D				
47.0	476	→	D	D					
68.0	686	D	D						
100.0	107	D	D						

Arrow indicates that next higher voltage is the standard rating available. Units will be marked with the highest voltage available for that case and capacitance rating. Devices rated at 6.3 volts will be marked 6 volts.

Case Outline Drawing



Application Notes

Capacitance—Dissipation Factor

Capacitance shall be measured at or referred to 120 Hz at 25°C. Maximum DC bias is 2.2 V. AC signal shall not exceed 1.0 VRMS.

Tolerance Available in 20%, and 10% cap tolerances.

Capacitance Change With Temperature from 25°C readings (maximum change):
at −55°C −10% △
at +85°C +10% △
at 125°C +12% △

Dissipation Factor (DF)

DF is determined by the same method as capacitance.

DC Leakage Current (DCL)

DCL shall be measured at WVDC after a 5 minute electrification period with a 1000 ohm current-limiting resistor in series.

Voltage Rating

All MOLDED CHIPS can be used at elevated temperatures when the working voltage is derated in accordance with the following table:

Rated WVDC −55°C to 85°C	Derated (DC) 125°C	Surge Voltage (DC) 85°C	125°C
4	2.5	5.0	3.4
6.3	4.0	8.0	5.0
10	6.3	13.0	9.0
16	10.0	20.0	12.0
20	13.0	26.0	16.0
25	16.0	32.0	20.0
35	23.0	46.0	26.0
50	33.0	65.0	38.0

Surge Voltage

The surge voltage is the maximum DC voltage, including AC or other pulses applied for short duration.

Reverse Voltage

Series 49MC MOLDED CHIP capacitors will withstand momentary voltage reversals up to 15% of their rated voltages at 25°C, 10% at 55°C, 5% at 85°C and 1% at 125°C.

MOLDED CHIP Electrical Limits & Case Codes

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	DF (max) 120Hz %	ESR (max)* 100KHz Ω	Case Code
3.3	4	0.5	5	6.0	6	20.0	A
4.7	4	0.5	5	6.0	6	20.0	A
10	4	0.5	5	6.0	6	4.5	B
15	4	0.6	6	7.2	6	4.5	B
22	4	0.9	9	10.8	6	3.0	C
33	4	1.3	13	15.6	6	2.5	C
68	4	2.8	28	33.6	6	2.0	D
100	4	4.0	40	48	8	1.5	D
2.2	6.3	0.5	5	6.0	6	15.0	A
3.3	6.3	0.5	5	6.0	6	15.0	A
6.8	6.3	0.5	5	6.0	6	4.5	B
10	6.3	0.6	6	7.2	6	4.5	B
15	6.3	0.9	9	10.8	6	3.0	C
22	6.3	1.4	14	16.8	6	2.5	C
47	6.3	2.9	29	34.8	6	1.8	D
68	6.3	4.1	41	49.2	6	1.5	D
100	6.3	6.0	60	72.0	8	1.5	D
1.5	10	0.5	5	6.0	6	15.0	A
2.2	10	0.5	5	6.0	6	15.0	A
4.7	10	0.5	5	6.0	6	4.5	B
6.8	10	0.7	7	8.4	6	4.5	B
10	10	1.0	10	12.0	6	3.0	C
15	10	1.5	15	18.0	6	2.5	C
33	10	3.3	33	39.6	6	1.8	D
47	10	4.7	47	56.4	6	1.5	D
1.0	16	0.5	5	6.0	4	15.0	A
1.5	16	0.5	5	6.0	6	15.0	A
3.3	16	0.6	6	7.2	6	5.0	B
4.7	16	0.8	8	9.6	6	5.0	B
6.8	16	1.1	11	13.2	6	3.0	C
10	16	1.6	16	19.2	6	2.5	C
22	16	3.6	36	43.2	6	1.8	D
33	16	5.3	53	63.6	6	1.5	D
.68	20	0.5	5	6.0	4	15.0	A
1.0	20	0.5	5	6.0	4	15.0	A
2.2	20	0.5	5	6.0	6	6.0	B
3.3	20	0.7	7	8.4	6	6.0	B

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	DF (max) 120Hz %	ESR (max)* 100KHz Ω	Case Code
4.7	20	1.0	10	12.0	6	3.0	C
6.8	20	1.4	14	16.8	6	2.5	C
15	20	3.0	30	36.0	6	1.8	D
22	20	4.4	44	52.8	6	1.5	D
.47	25	0.5	5	6.0	4	18.0	A
1.5	25	0.5	5	6.0	6	7.0	B
3.3	25	0.9	9	10.8	6	4.0	C
4.7	25	1.2	12	14.4	6	3.0	C
6.8	25	1.7	17	20.4	6	2.5	D
1.0	25	2.5	25	30.0	6	2.0	D
15	25	3.8	38	45.6	6	1.5	D
.10	35	0.5	5	6.0	4	24.0	A
.15	35	0.5	5	6.0	4	21.0	A
.22	35	0.5	5	6.0	4	19.0	A
.33	35	0.5	5	6.0	4	18.0	A
.47	35	0.5	5	6.0	4	11.0	B
.68	35	0.5	5	6.0	4	8.0	B
1.0	35	0.5	5	6.0	4	7.0	B
1.5	35	0.5	5	6.0	6	6.0	C
2.2	35	0.8	8	9.6	6	4.0	C
3.3	35	1.2	12	14.4	6	3.0	C
4.7	35	1.7	17	20.4	6	2.5	D
6.8	35	2.4	24	28.8	6	2.0	D
10	35	3.5	35	42.0	6	1.5	D
.10	50	0.5	5	6.0	4	22.0	A
.15	50	0.5	5	6.0	4	19.0	B
.22	50	0.5	5	6.0	4	16.0	B
.33	50	0.5	5	6.0	4	13.0	B
.47	50	0.5	5	6.0	4	9.0	C
.68	50	0.5	5	6.0	4	7.0	C
1.0	50	0.5	5	6.0	4	6.0	C
1.5	50	0.8	8	9.6	6	5.0	D
2.2	50	1.1	11	13.2	6	3.5	D
3.3	50	1.7	17	20.4	6	2.0	D
4.7	50	2.4	24	28.8	6	1.5	D

AC Power Dissipation

Case Code	Maximum Power Dissipation in Watts Ambient Temperature		
	25°C	85°C	125°C
A	.075	.067	.030
B	.085	.077	.035
C	.110	.100	.045
D	.150	.135	.060

Major physical factors which limit the ability of the capacitor to dissipate internally generated heat produced during AC circuit operation, include unit construction features as related to a particular capacitor design, and heat transfer characteristics of the materials used in the construction of the capacitor. Larger volumetric packages exhibiting electrical characteristics similar to those of smaller physical packages will, under similar conditions, be capable of dissipating more power.

Maximum power dissipation levels shown represent an empirically determined wattage level required to cause a 10 degree centigrade temperature increase above the stated temperature in "still air" as measured on the external capacitor body, utilizing a thermo-couple or other appropriate measuring device.

AC Ripple Current

Circuit design and physical layout should provide "cool" circuit board locations for capacitors operating at high AC current levels. Capacitor temperature may increase due to heat transfer/absorption from the ambient environment or a "hot" component mounted in close proximity to the capacitor. The result of increased AC current is increased internal heat generation within the capacitor body. Waveform envelope is also a factor in the amount of internal heat generated within the capacitor since non-sinusoidal waveshapes produce heating effects different from those of sinusoidal waveforms.

The ripple current and voltage level impressed across the capacitor should not exceed the maximum power dissipation of the capacitor unless special provisions are made to increase the rate of heat dissipation from the body of the capacitor, such as by the use of a heat sink or providing air flow. Excessive power dissipation in tantalum chip capacitors may cause catastrophic failure. The I_{max} value of current must be used to determine the operating conditions.

The maximum permissible AC (rms) current applied across the capacitor is related to the equivalent series resistance (ESR) and the physical power dissipation capability of the capacitor. The maximum (rms) ripple current at a given frequency may be determined by:

$$I_{max}(rms) = \sqrt{Pdm/ESR}$$

where. . . Pdm = Maximum Power Dissipation in watts, at the maximum circuit operating temperature

$$ESR = \frac{1}{2\pi * \text{AC Frequency} * \text{Capacitance}} * \text{D.F.}$$

AC Frequency in Hertz
Capacitance is in Farads
Dissipation Factor is in decimal form

AC Ripple Voltage

The maximum AC ripple voltage at the applied frequency must be limited to an rms value which permits only the recommended maximum power dissipation specified for a given case code.

The maximum AC ripple voltage may be determined by:

$$E_r\ (rms) = Z\sqrt{Pdm/ESR}$$

where. . . E_r = AC Ripple Voltage
Z is the Impedance in ohms
Pdm is the Maximum Power Dissipation in watts, at the maximum circuit operating temperature
ESR is the Equivalent Series Resistance in ohms

Both voltage and current levels at a given frequency must be maintained so as not to exceed the recommended maximum power dissipation levels at the maximum circuit operating temperature. The DC bias voltage applied in series with the AC source applied across polar style capacitors, on which the AC voltage is "riding," may be ignored when considering the heating effects of AC current on the capacitor. The positive peak AC voltage plus the DC voltage must not exceed the rated DC voltage of the capacitor. The negative peak AC voltage in combination with the DC voltage may not obtain a level which will damage the dielectric due to reverse voltage being applied across a polar solid electrolyte tantalum chip capacitor.

Non-Polar Operation

When two polar capacitors of the same DC voltage rating are connected back-to-back in non-polar configuration, i.e. positive-to-positive terminals or negative-to-negative terminals; the "non-polar" pair may be operated without DC bias voltage. If DC voltage is applied, the positive peak AC voltage plus the DC voltage must not exceed the rated voltage of the capacitor in either direction.

Markings

The small physical size of the MOLDED CHIP dictates a minimum amount of alpha-numeric marking on the body of the capacitor. The capacitance in picofarad code and the Rated Working Voltage (DC) will be marked on the B, C, and D case size units. The A case size units may have the capacitance only, marked in picofarad code. All case sizes will have positive polarity indicated at the anode termination. Capacitance may be marked in μF at the manufacturer's option. Newer devices now marked with manufacturing date code.

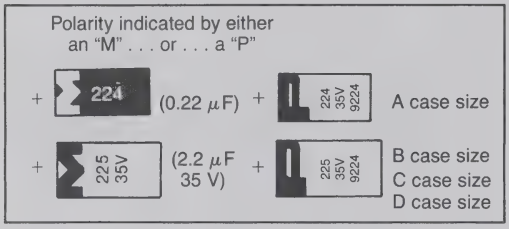
Flammability

49MC encapsulant materials meet UL94 VO flammability classification.

Polarity (Philips Components Unit Identifier) (Positive Termination Indicator)

Series 49MC capacitors are polar devices. Proper polarity must be observed or damage to the capacitor and/or the circuit will result. Polarity is marked with the letter "P" on the positive end and will also serve as the Philips Components identifier.

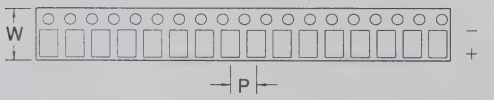
Marking Examples by Case Size



Packaging

Tape & Reel

49MC Series capacitors are shipped in Tape & Reel packaging to facilitate the use of automatic placement equipment. Tape & Reel is per EIA (Electronic Industries Association) specification RS 481. Capacitor orientation within the tape pockets is negative terminal toward sprocket holes and mounting side down. 8 and 12 mm tape widths are used according to case size.



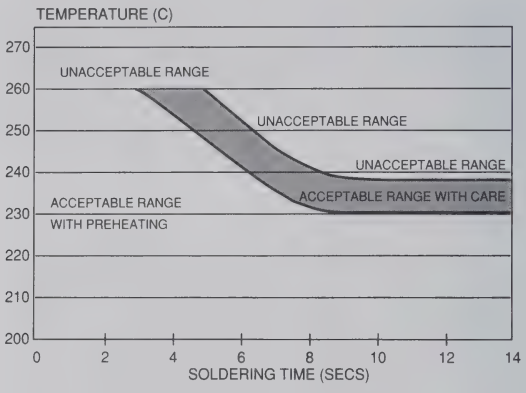
Tape & Reel Specifications

Case Size	(W) Tape Width	(P) Unit Pitch Ctr/Ctr	Quantity per full 7″ Reel	Quantity per full 13″ Reel
A	8 mm	4 mm	2,000	9,000
B	8 mm	4 mm	2,000	8,000
C	12 mm	8 mm	500	3,000
D	12 mm	8 mm	500	2,500

Soldering Profiles for Reflow

Soldering time and temperature should be kept to the minimum required for a good connection. Wave soldering can be very suitably performed at 230–250 degrees C over a period of 3–5 seconds. Infrared or vapor phase techniques should refer to the profile shown below. This profile ensures that the peak reflow and dwell time range does not allow the internal construction to exceed 220 degrees C. A maximum of 150 degrees C with a 10 minute dwell is recommended for the preheating profile. Slight parametric shifts in performance of the devices may be noted immediately following reflow. For this reason, it is recommended that a brief period of stabilization occur at ambient temperature prior to any electrical testing.

Recommended Reflow Time and Temperature



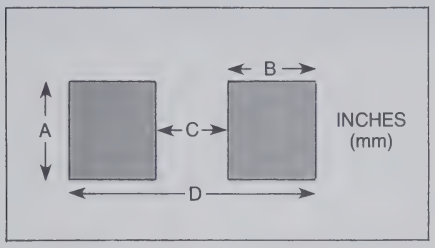
Solderability Inspection Criteria

Magnification: 10X

Both termination end faces, excluding the areas of the terminations egressing from the package, shall be covered with a smooth and bright solder coating with no more than a small amount of scattered imperfections, such as pinholes or unwetted or de-wetted areas. The imperfections shall not be concentrated in one area.

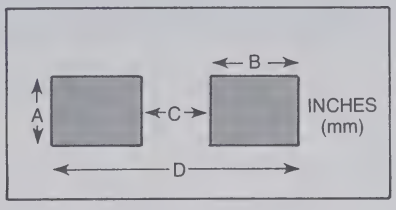
Termination edges are not solderable surfaces.

Recommended Pad Dimensions for Reflow Soldering



Case Size	A Min.	B Min.	C Nom.	D Nom.
A	.071 (1.80)	.060 (1.53)	.053 (1.35)	.223 (5.65)
B	.110 (2.80)	.060 (1.53)	.065 (1.65)	.235 (5.95)
C	.110 (2.80)	.082 (2.08)	.124 (3.15)	.337 (8.55)
D	.118 (3.00)	.082 (2.08)	.176 (4.45)	.388 (9.85)

Recommended Pad Dimensions for Wave Soldering



Case Size	A Min.	B Min.	C Nom.	D Nom.
A	.034 (0.87)	.065 (1.65)	.053 (1.35)	.223 (5.65)
B	.061 (1.54)	.065 (1.65)	.065 (1.65)	.235 (5.95)
C	.061 (1.54)	.087 (2.20)	.124 (3.15)	.337 (8.55)
D	.066 (1.68)	.087 (2.20)	.176 (4.45)	.389 (9.85)

CWR11 Established Reliability

Series 49MC MOLDED CHIP capacitors are qualified to both Exponential Failure Rate Level (M and P) and Weibull Graded Failure Rate Levels (B, C, and D) under specification MIL-C-55365/8, Style CWR11.

Philips Components provides the CWR11 MOLDED CHIP in only the "H" style termination, Solder plated (100 Mμ min.) alloy 752.

The military part numbering system and electrical parameter limits for Dissipation Factor and DC Leakage are covered on the following pages. Test information from the military specification follows that, but it is recommended that you obtain the specification and its attendant documents for further clarification of tests and procedures.

Style CWR11 Established Reliability Military Style Tantalum Chip Capacitors

MIL-C-55365/8 Military Part Numbering System Example

NOTE: Military Part number does not designate case code

CWR11 D F 225 K M

- **M** — **Failure Rate** in percent per 1,000 hours—M = 1%, P = 0.1% B = 0.1% C = 0.01% D = 0.0%
- **K** — **Capacitance Tolerance** J = 5%, K = 10%, M = 20%
- **225** — **Capacitance, Nominal,** in Picofarad Code—First two digits are significant figures, third digit is number of zeros to follow.
- **F** — **Termination Finish**—H = Solder Plated Alloy 752
- **D** — **Rated Voltage** AT 85°C— D = 6 H = 15 K = 25 N = 50 F = 10 J = 20 M = 35
- **CWR11** — **Style CWR11 Tantalum Chip Capacitor.**

CWR11 Electrical Limits & Military Case Codes

Cap. (nom) µF	Rated VDC 85° C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	Dissipation Factor (max) 25°C %	85°C 125°C	−55°C %	ESR (max) 100KHz 25°C	Case Code (Mil)
2.2	6	0.5	5.0	6.0	6	6	9	15.0	A
6.8	6	0.5	5.0	6.0	6	6	9	4.5	B
15	6	0.9	9.0	10.8	6	6	9	3.0	C
47	6	2.8	28.0	33.6	6	6	9	1.8	D
1.5	10	0.5	5.0	6.0	6	6	9	15.0	A
4.7	10	0.5	5.0	6.0	6	6	9	4.5	B
15	10	1.5	15.0	18.0	6	6	9	2.5	C
33	10	3.3	33.0	39.6	6	6	9	1.8	D
1.0	15	0.5	5.0	6.0	4	6	6	15.0	A
3.3	15	0.5	5.0	6.0	6	8	9	5.0	B
10	15	1.6	16.0	19.2	6	8	9	2.5	C
22	15	3.3	33.0	39.6	6	8	9	1.8	D
.68	20	0.5	5.0	6.0	4	6	6	15.0	A
2.2	20	0.5	5.0	6.0	6	8	9	6.0	B
4.7	20	1.0	10.0	12.0	6	8	9	3.0	C
15	20	3.0	30.0	36.0	6	8	9	1.8	D
.47	25	0.5	5.0	6.0	4	6	6	18.0	A
1.5	25	0.5	5.0	6.0	6	8	9	7.0	B
3.3	25	0.9	9.0	10.8	6	8	9	4.0	C
10	25	2.5	25.0	30.0	6	8	9	2.0	D
.10	35	0.5	5.0	6.0	4	6	6	24.0	A
.15	35	0.5	5.0	6.0	4	6	6	21.0	A
.22	35	0.5	5.0	6.0	4	6	6	19.0	A
.33	35	0.5	5.0	6.0	4	6	6	18.0	A
.47	35	0.5	5.0	6.0	4	6	6	11.0	B
.68	35	0.5	5.0	6.0	4	6	6	8.0	B
1.0	35	0.5	5.0	6.0	4	6	6	7.0	B
1.5	35	0.5	5.0	6.0	6	8	9	6.0	C
2.2	35	0.8	8.0	9.6	6	8	9	4.0	C
3.3	35	1.2	12.0	14.4	6	8	9	3.0	D
4.7	35	1.7	17.0	20.4	6	8	9	2.5	D
.10	50	0.5	5.0	6.0	4	6	6	22.0	A
.15	50	0.5	5.0	6.0	4	6	6	19.0	B
.22	50	0.5	5.0	6.0	4	6	6	16.0	B
.33	50	0.5	5.0	6.0	4	6	6	13.0	B
.47	50	0.5	5.0	6.0	4	6	6	9.0	C
.68	50	0.5	5.0	6.0	4	6	6	7.0	C
1.0	50	0.5	5.0	6.0	4	6	6	6.0	C
1.5	50	0.8	8.0	9.6	6	8	9	5.0	D
2.2	50	1.1	11.0	13.2	6	8	9	3.5	D

MIL-C-55365/8—Test and Conditions (Excerpts from the Military Specification)

Capacitance

Capacitors shall be tested in accordance with MIL-STD-202, method 305. The following details shall apply:

(a) Test frequency: 120 ±5 Hertz.
(b) Limit of accuracy: Measurement accuracy shall be within ±2 percent of the reading.
(c) Magnitude of polarizing voltage—Maximum DC bias shall be 2.2 volts for all AC measurements. The magnitude of the AC voltage shall be limited to 1.0 volts RMS.

Dissipation Factor

The dissipation factor of each capacitor shall be measured at a frequency of 120 ±5 Hertz (Hz) by means of a polarized capacitance bridge. The bridge shall provide a dial reading accuracy of 0.1% dissipation factor and a measuring accuracy of ± (2 percent of the measured dissipation factor plus 0.1%).

D.C. Leakage

D.C. leakage shall be measured using the DC rated voltage at ±2 percent at the applicable test temperature after a maximum electrification period of 5 minutes. A 1,000-ohm resistor shall be placed in series with the capacitor to limit the charging current. A steady source of power, such as a regulated power supply, shall be used. Measurement accuracy shall be within ±2 percent or 0.02 microamps (µa), whichever is greater.

Equivalent Series Resistance (ESR)

The ESR at the applicable temperature shall be measured directly or determined from measurements obtained from a bridge. The following details shall apply:

(a) Test temperature and tolerance: 25°C ±5°C
(b) Test frequency: 100 kHz ±5kHz
(c) Limit of accuracy: Within ±5.0 percent of the reading
(d) Magnitude of polarizing voltage: Unless otherwise specified, the maximum dc bias shall be 2.2 volts for all measurements. The magnitude of the ac voltage shall be limited to 0.5 volt rms maximum.

Thermal Shock

Capacitors shall be tested in accordance with MIL-STD-202, method 107. The following details and exceptions shall apply:

(1) Mounting of specimens: Chip capacitors shall be mounted on suitable substrate. The substrate material shall be such that it shall not be cause of, nor contribute to, failure of any test for which it may be used. The capacitors shall be mounted on the substrate as follows:

(a) A substrate shall be prepared with metalized surface land areas of proper spacing to permit mounting of chips by soldering the terminations of the chips to the "test card" land areas.
(b) Solder paste, type "R" or "RMA" in accordance with QQ-S-571, shall be applied to terminals or substrates as applicable.

(c) The chip shall then be placed across the metalized land areas of the substrate so as to make contact between chip and substrate land areas.
(d) The substrate shall then be placed in or on a suitable heat transfer unit at a temperature of 135°C ± 15°C for 1.0 ± 0.1 minute. The substrate shall then be placed upon or enter the 245°C ± 5°C hot-plate or tunnel oven. The substrate shall remain on the hot-plate or tunnel oven at 245°C ± 5°C until the solder paste melts and reflows forming a homogeneous solder bond to the metalized substrate.
(e) All excess flux or solder shall be removed.

(2) Test condition letter: B
(3) Measurements after thermal shock: DC leakage—meet original requirement; Capacitance—shall change no more than 5% from initial measurement; Dissipation Factor—meet original requirement; ESR-meet original requirement.
(4) Visual requirements: There shall be no evidence of harmful corrosion or mechanical damage or obliteration of marking.

Vibration, High Frequency

Capacitors shall be tested in accordance with MIL-STD-202, method 204. The following details and exceptions shall apply:

(a) Mounting of specimens—Capacitors shall be mounted on a substrate as specified under thermal shock.
(b) Electrical-load conditions—During the test, the specified DC rated voltage shall be applied to the capacitors.
(c) Test condition letter—D (20 G's).
(d) Duration and direction of motion—4 hours in each of two mutually perpendicular directions (total of 8 hours), one parallel and the other perpendicular to the axis.
(e) Measurements during vibration—During the last cycle, an electrical measurement shall be made to determine intermittent operation or open or short circuiting. Observations shall also be made to determine intermittent contact or arcing or open or short circuiting. Detecting equipment shall be sufficiently sensitive to detect any interruption with a duration of 0.5 ms or greater.
(f) Measurements after vibration—Not applicable.
(g) Examination after test—Capacitors shall be visually examined for evidence of mechanical damage.

Resistance to Soldering Heat

Capacitors shall be tested in accordance with MIL-STD-202, method 210. The following details and exceptions shall apply:

(a) Mounting of speciments—Chip Capacitors shall be mounted on a substrate as specified in Thermal Shock except the post pre-heat hot-plate temperature shall be 260°C ± 5°C for a duration of 5 seconds ± 0.5 second.
(b) Test condition letter—C
(c) Post test conditioning: The capacitors shall be inserted in a vapor degreasing apparatus containing boiling 1-1-1 trichloroethane for 1.5 minutes +0.5, −0 minute. The parts shall then be cleaned with isopropyl alcohol.
(d) Measurements after test: Following a minimum 3 hour cooling period; DC leakage-meet original requirement; Capacitance-shall change not more than ±5 percent from initial measurement; Dissipation Factor-meet original requirement.
(e) Examination after test—Capacitors shall be visually examined for evidence of mechanical damage.

Moisture Resistance

Capacitors shall be tested in accordance with MIL-STD-202, method 106. The following details and exceptions shall apply:

(a) Mounting of specimens—Capacitors shall be mounted as specified in Thermal Shock.
(b) Initial measurements—Capacitance as specified above.
(c) Number of cycles—20 continuous cycles except that steps 7a and 7b shall be omitted.
(d) Loading voltage—Not applicable.
(e) Final measurements—After removal from chamber, capacitors shall be dried for 1 hour at room temperature and, within the next hour, DC leakage, Capacitance, Dissipation Factor and ESR shall be measured as specified above.
(f) Examination after test—Capacitors shall be visually examined for evidence of corrosion and mechanical damage.

When tested as specified, capacitors shall meet the following requirements:

(a) DC Leakage—Shall not exceed 200% of the requirement specified.
(b) Capacitance—Shall not change more than ±15% from the initial measured value.
(c) Dissipation Factor—Shall not exceed 150% of the requirement specified.
(d) ESR—Shall meet applicable value specified.
(e) Visual examination—There shall be no evidence of harmful corrosion, mechanical damage or obliteration of marking.

Stability at Low and High Temperature

Capacitors shall be dried at 125°C for 30 (+4, −0) minutes prior to start of test. The capacitors shall be brought to thermal stability at each test temperature. Thermal stability will have been reached when no further change in capacitance is observed between two successive measurements taken at 15, +2 −0 minute, intervals. Capacitors will meet the following requirements as applicable:

Step 1 (25°C Initial measurements):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within tolerance of the nominal value.
Dissipation factor—Shall not exceed the requirement specified.
ESR—Shall meet applicable value specified.

Step 2 (−55°C):
Capacitance—Shall be within ±10% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 3 (25°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within 5% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 4 (85°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within 10% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 5 (125°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within ±12% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 6 (25°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within 5% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.
ESR—Shall meet applicable value specified.

Surge Voltage

Capacitors shall be subjected to 1,000 cycles of the applicable surge voltage. The ambient temperature during cycling shall be 85°C. Each cycle shall consist of a 30-second surge voltage application followed by a 30-second discharge period. Voltage application shall be made through a resistor of 33 ohms. The tolerance of the resistor shall be ±5 percent. Each surge voltage cycle shall be performed in such a manner that the capacitor is shorted terminal-to-terminal through a copper bar, or an equivalent low resistance at the end of the 30-second application. An alternative method of shorting the capacitors is discharge through the same resistance that is utilized for charging. After the final cycle, the capacitor shall be stabilized at the inspection conditions, and the DC leakage, Capacitance, and ESR shall be measured. When tested as specified, capacitors shall meet the following requirements:

DC Leakage—Shall not exceed the requirement specified.
Capacitance—Shall change not more than ±5% from initial value.
Dissipation Factor—Shall not exceed the requirement specified.
ESR—Shall meet applicable value specified.

Life Test

A. Capacitors shall be tested in accordance with MIL-STD-202, method 108. The following details and exceptions shall apply:
   (a) Method of mounting—as detailed under thermal shock.
   (b) Test conditions
      (1) Proof Life
         2,000 hours
         125°C
         Derated voltage applied
      (2) Failure Rate Life
         10,000 hours
         85°C
         Rated voltage applied

B. Operating conditions—DC rated voltage 85°C or derated voltage at 125°C, as applicable, shall be applied gradually (not to exceed 5 minutes) either by a slow build up of the voltage or through a resistor which shall be shorted out within 5 minutes. Voltage shall be applied continuously except during measurement period. The impedance of the voltage source, as seen from the terminals of each capacitor, shall not exceed three ohms. Storage batteries or an electronic power supply capable of supplying at least one ampere when a capacitor is shorted shall be used.

C. Measurements during exposure—DC leakage, at the applicable high test temperature and voltage, shall be measured at the following intervals: 0 hours, 240 hours, 1000 hours, 2000 hours, 4000 hours*, 6000 hours*, 8000 hours*, 10,000 hours*.
*Failure rate (85°C) life only.

D. Measurements after exposure—Capacitors shall be returned to 25°C and visually examined for evidence of harmful corrosion or mechanical damage. DC leakage, Capacitance and Dissipation Factor will then be measured as specified.

Following testing there shall be no evidence of harmful corrosion or mechanical damage and the capacitors will meet the following electrical requirements:

2,000 hours:
at 25°C DCL—initial requirement.
△Cap— ±5% of initially measured value.
DF—initial requirement.
ESR—initial requirement.
at 85°C DCL—initial requirement.
at 125°C DCL—initial requirement.

10,000 hours:
at 25°C DCL—200% of initial requirement.
△Cap—within ±10% of initial measurement.
DF—initial requirement.
at 85°C DCL—200% of initial requirement.
at 125°C DCL—200% of initial requirement.

Marking

In accordance with MIL-C-55365, capacitors shall be marked as follows:

J J = JAN marked in polarity (+) stripe
105 capacitance in picofarad code
35P rated voltage, manufacturer's trademark

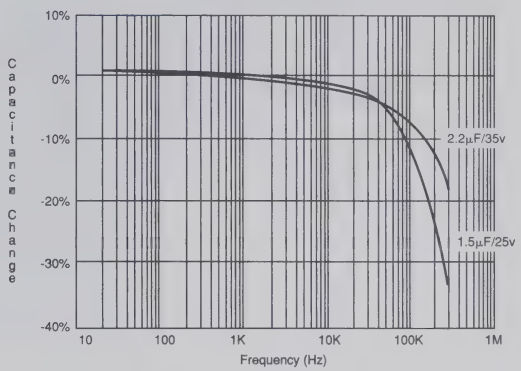
Solderability

Capacitors shall be tested in accordance with MIL-STD-202, method 208. Mounting surfaces shall be dipped to cover the normal mounting surfaces. After the test the solderable surfaces shall be at least 95% covered with a smooth solder coating and shall exhibit no demetallization or leaching of the terminal ends. The remaining 5% may contain only small pin holes or rough spots, these shall not be concentrated in one area.

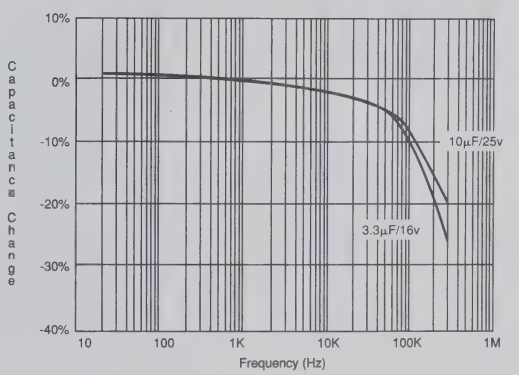
Solderable surfaces include the mounting surface and half-way up the vertical face of the termination. Termination edges are not considered solderable.

Typical Characteristics

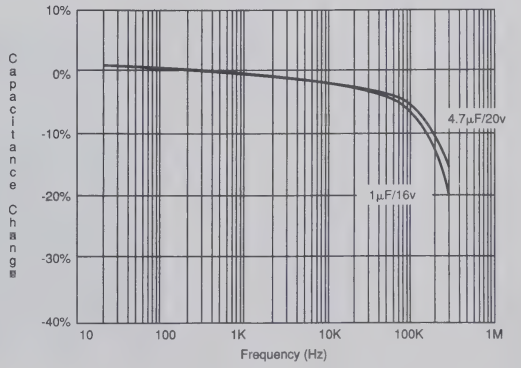
Capacitance Change with Frequency



Capacitance Change with Frequency

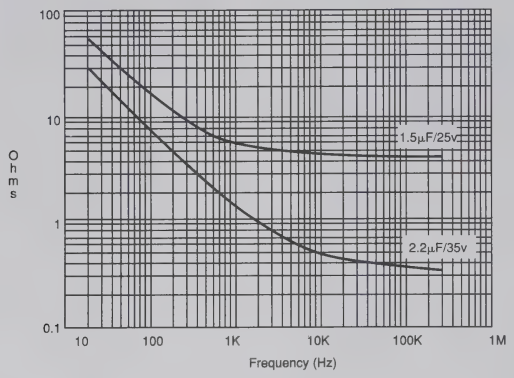


Capacitance Change with Frequency

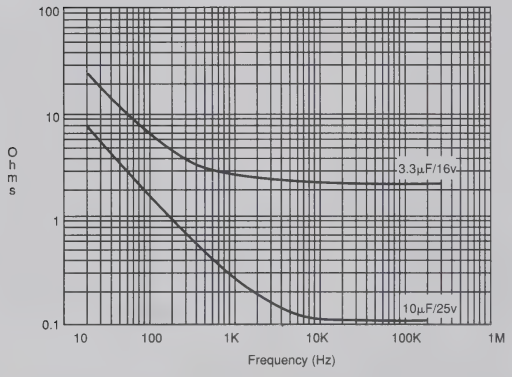


Typical Characteristics

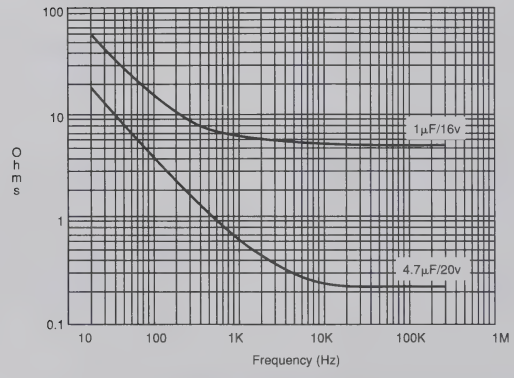
ESR vs Frequency

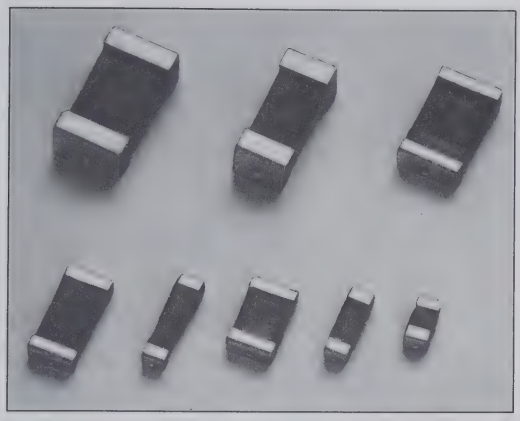


ESR vs Frequency



ESR vs Frequency





EXTENDED RANGE Tantalum SMD® (Chip) Capacitors, Series 49EC

Description

The 49EC EXTENDED RANGE Series surface mounted solid tantalum chip capacitor provides some of the highest capacitance densities, the smallest physical package size available for a specific capacitance-voltage rating, of any surface mountable tantalum chip series available. This conformally coated tantalum chip series has been designed specifically for hybrid circuit applications requiring the ultimate in micro-miniaturization and operating reliability. The 49EC product is an extension of the BLUE CHIP capacitor series, which is the world standard for high-reliability tantalum chip capacitors.

The 49EC series is provided in eight case sizes which are "pad compatible" and identical to the physical case sizes defined in the military Established Reliability Tantalum Capacitor Specification MIL-C-55365/4, for CWR06 style capacitors. The product is available with gold plated or hot solder-dipped (60/40) terminations.

This Extended Range capacitor series provides on the order of two to three times the capacitance-voltage rating, in the same case size as specified for 49BC series capacitors. This permits "down-sizing" by up to two case sizes for a specific 49BC capacitance-voltage rating, while maintaining the electrical performance requirements for standard 49BC devices. "Down-sizing" not only provides a significant improvement in volumetric efficiency, but can reduce unit height by up to 0.040 inches, allowing for a height reduction in hermetically-sealed hybrid circuits.

Philips Components manufactures the 49EC product utilizing advanced Statistical Process Controls under a company-wide quality improvement program. State-of-the-art manufacturing processes provide uniform performance characteristics.

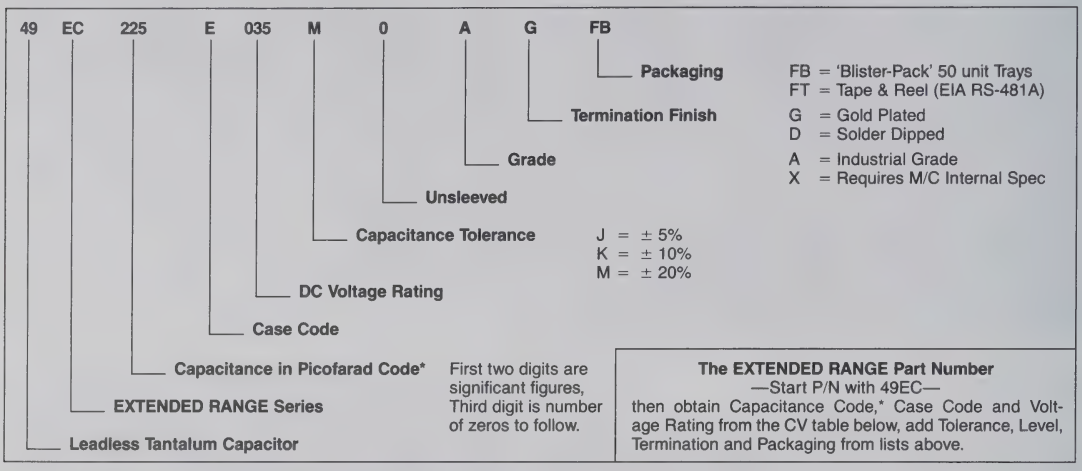
The 49EC EXTENDED RANGE series is available as industrial grade product or may be processed to customer specified conditioning and/or screening requirements. Philips Components technical and engineering staff is available to our customers who require assistance in specifying a capacitor for their application.

Features

- −55°C through +85°C Operation (125°C with Voltage Derating)
- Capacitance Range: 0.47 μF to 220 μF
- Rated Voltages: 4 VDC to 35 VDC
- Eight Standard Case Sizes-Pad Compatible with MIL-C-55365/4 CWR06
- High Volumetric Efficiency (Up to 200,000 CV per cubic inch)
- Low Profile-Conformally Coated Construction
- 100% Low Impedance Power Burn-in at 85°C
- Low ESR in High Frequency Applications
- Packaging in 50-unit 'Blister-Pack' trays or 8 or 12 mm Tape & Reel

Part Number Designation

Philips Components Series 49EC EXTENDED RANGE Capacitors can be completely specified using the following designation:


49 EC 225 E 035 M 0 A G FB
Packaging
FB = 'Blister-Pack' 50 unit Trays
FT = Tape & Reel (EIA RS-481A)
Termination Finish
G = Gold Plated
D = Solder Dipped
Grade
A = Industrial Grade
X = Requires M/C Internal Spec
Unsleeved
Capacitance Tolerance
J = ± 5%
K = ± 10%
M = ± 20%
DC Voltage Rating
Case Code
Capacitance in Picofarad Code*
First two digits are significant figures, Third digit is number of zeros to follow.
EXTENDED RANGE Series
Leadless Tantalum Capacitor
The EXTENDED RANGE Part Number
—Start P/N with 49EC—
then obtain Capacitance Code,* Case Code and Voltage Rating from the CV table below, add Tolerance, Level, Termination and Packaging from lists above.

49EC Capacitance—Voltage—Case Code Table

Select standard Capacitance/Voltage ratings and corresponding standard EXTENDED RANGE case codes from this table.

CAP μF	Picofarad Code*	004 V	006 V	010 V	015 V	020 V	025 V	035 V
0.47	474	→	→	→	→	→	→	B
1.0	105	→	→	→	→	→	B	L
1.5	155	→	→	→	→	B	L	U
2.2	225	→	→	→	B	L	U	E
3.3	335	→	→	B	L	U	E	C
4.7	475	→	B	L	U	E	C	H
6.8	685	B	L	U	E	C	→	H
10	106	L	U	E	C	→	H	I
15	156	U	E	C	→	→	H	P
22	226	E	C	→	→	H	I	
33	336	C	→	→	H	I	P	
47	476	→	→	H	I	P		
68	686	→	H	I	P			
100	107	H	→	P				
120	127	→	I					
150	157	I	P					
220	227	P						

®SMD is a Service Mark of North American Philips Corporation
®BLUE CHIP is a Registered Trade Mark. The BLUE CHIP is patented under US Patent No. 3,855,505

Physical Specifications

Dimensions—Inches

Case Code	(W) Width ±0.015	(L) Length ±0.015	(H) Height ±0.015	(S) Spacing Typical	(B) Pad Width ±0.005
B	.050	.100	.050	.040	.030
L	.050	.150	.050	.090	.030
U	.050	.200	.050	.140	.030
E	.100	.150	.050	.090	.030
C	.100	.200	.050	.140	.030
H	.135	.220	.070	.160	.030
I	.110	.265	.110	.165	.050
P	.150	.285	.110	.185	.050

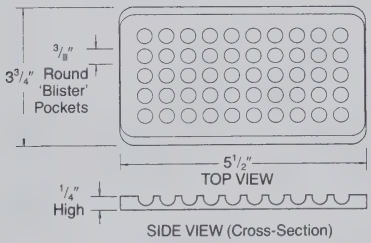
Dimensions—mm

Case Code	(W) Width ±0.381	(L) Length ±0.381	(H) Height ±0.381	(S) Spacing Typical	(B) Pad Width ±0.127
B	1.27	2.54	1.27	1.02	0.76
L	1.27	3.81	1.27	2.29	0.76
U	1.27	5.08	1.27	3.55	0.76
E	2.54	3.81	1.27	2.29	0.76
C	2.54	5.08	1.27	3.55	0.76
H	3.43	5.59	1.78	4.06	0.76
I	2.79	6.73	2.79	4.19	1.27
P	3.81	7.25	2.79	4.70	1.27

Packaging

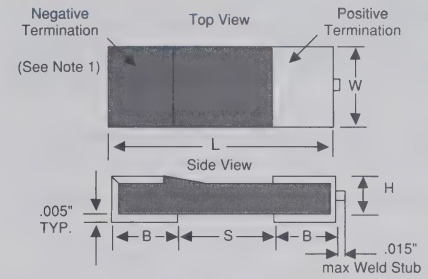
Blister-Pack Trays

49EC Series capacitors are shipped in 'Blister-Pack' trays containing 50 pieces each in a 5 × 10 matrix configuration. The 'Blister-Pack' provides a separate pocket for each unit to prevent damage to the capacitors during shipping, handling and storage.



Orientation of the capacitors within the tray pockets is random with respect to polarity and mounting surface. This packaging is ideal for hand placement of the capacitors as it takes up very little room at the work station. It is recommended that operators remove and handle these capacitors using a blunt, coated tweezer to prevent damage to the Blue Seal coating.

Case Outline Drawing

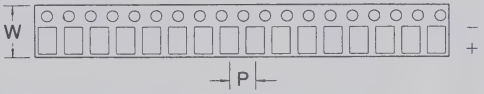


Notes:

1. For polarity identification, when chip is in mounting position, bare metal clip and weld stub are positive. The top surface of the negative terminal is blue.
2. Metric Equivalents are for general information purposes only and are based on 1″ = 25.4 mm.
3. Anode Riser (Weld Stub) may extend case size. Length dimension by 0.015″ (.38 mm) max.
4. Dimensions given are for gold-plated terminations. For solder-dipped terminations, add + 0.015″ (.38 mm) to dimension tolerances.
5. Spacing dimension is average distance between chip mounting terminations and therefore maximum distance between mounting pads on substrate.

Tape & Reel

EXTENDED RANGE Series capacitors are available in Tape & Reel packaging to facilitate the use of automatic placement equipment. Tape & Reel is per EIA (Electronic Industries Association) specification RS-481. Capacitor orientation within the tape pockets is negative terminal toward sprocket holes and mounting side down. Quantities less than minimum reel will be shipped in Blister-Pack trays.



Tape & Reel Specifications

49EC Case Code	(W) Tape Width	(P) Unit Pitch Ctr/Ctr	Quantity per Full 7″ Reel	Minimum Quantity per Reel
B	8 mm	4 mm	3,000	1,500
L	12 mm	4 mm	3,000	1,500
U	12 mm	4 mm	3,000	1,500
E	12 mm	4 mm	2,700	1,350
C	12 mm	4 mm	2,700	1,350
H	12 mm	8 mm	1,000	500
I	12 mm	8 mm	700	350
P	12 mm	8 mm	700	350

Application Notes

Capacitance

Capacitance shall be measured at 120 Hz at 25°C. Maximum DC bias is 2.2 V. The AC signal shall not exceed 1.0 VRMS.

Tolerance: ±20%, ±10% and ±5% cap tolerances are available.

Capacitance Change with Temperature from 25°C (max):

Temperature	−55°C	+85°C	+125°C
Max. Cap Change	−10%	+10%	+15%

Dissipation Factor

The dissipation factor shall be measured at a frequency of 120 Hz by means of a polarized capacitance bridge.

DC Leakage Current (DCL)

DCL shall be measured at WVDC after a maximum electrification period of 5 minutes with a 1000 ohm current-limiting resistor in series.

Voltage Rating

All EXTENDED RANGE chips can be used at elevated temperatures when the working voltage is derated in accordance with the following table.

Rated WVDC −55°C to +85°C	Derated (DC) +125°C	Surge Voltage (DC) +85°C	Surge Voltage (DC) +125°C
4	2.7	5.0	3.4
6	4.0	8.0	5.0
10	7.0	13.0	9.0
15	10.0	20.0	12.0
20	13.0	26.0	16.0
25	17.0	32.0	20.0
35	23.0	46.0	26.0
50	33.0	65.0	38.0

Surge Voltage

The surge voltage is the maximum DC voltage, including AC or other pulses applied for a short duration.

EXTENDED RANGE Chip Electrical Limits & Case Codes

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	D.F. (max) 120 Hz %	ESR (max) 100KHz Ω	Case Code
6.8	4	0.5	5	6	6	3.5	B
10	4	0.5	5	6	8	2.0	L
15	4	0.6	6	8	8	1.5	U
22	4	0.9	9	11	8	1.0	E
33	4	1.4	14	17	8	1.0	C
100	4	4.0	40	48	10	0.5	H
150	4	6.0	60	72	10	0.5	I
220	4	9.0	90	108	10	0.5	P
4.7	6	0.5	5	6	6	3.5	B
6.8	6	0.5	5	6	6	2.0	L
10	6	0.6	6	8	8	1.5	U
15	6	0.9	9	11	8	1.0	E
22	6	1.4	14	17	8	1.0	C
68	6	4.0	40	48	10	0.7	H
120	6	8.0	80	96	10	0.5	I
150	6	9.0	90	108	10	0.5	P
3.3	10	0.5	5	6	6	3.5	B
4.7	10	0.5	5	6	6	2.0	L
6.8	10	0.7	7	9	6	2.0	U
10	10	1.0	10	12	8	1.5	E
15	10	1.5	15	18	8	1.0	C
47	10	4.7	47	57	10	0.7	H
68	10	7.0	70	84	10	0.7	I
100	10	10.0	100	120	10	0.5	P
2.2	15	0.5	5	6	6	4.0	B
3.3	15	0.5	5	6	6	2.5	L
4.7	15	0.8	8	10	6	2.5	U
6.8	15	1.0	10	12	6	2.0	E
10	15	1.5	15	18	6	1.5	C

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	D.F. (max) 120 Hz %	ESR (max) 100KHz Ω	Case Code
33	15	5.0	50	60	8	0.8	H
47	15	8.0	80	96	8	0.8	I
68	15	11.0	110	132	8	0.8	P
1.5	20	0.5	5	6	6	6.0	B
2.2	20	0.5	5	6	6	3.5	L
3.3	20	0.7	7	9	6	3.0	U
4.7	20	1.0	10	12	6	2.5	E
6.8	20	1.4	14	17	6	2.0	C
22	20	4.0	40	48	6	1.0	H
33	20	7.0	70	84	6	1.0	I
47	20	10.0	100	120	6	1.0	P
1.0	25	0.5	5	6	6	8.0	B
1.5	25	0.5	5	6	6	5.0	L
2.2	25	0.6	6	8	6	3.5	U
3.3	25	0.9	9	11	6	3.5	E
4.7	25	1.2	12	15	6	2.5	C
10	25	2.5	25	30	6	2.0	H
15	25	3.8	38	46	6	1.0	H
22	25	6.0	60	72	6	1.0	I
33	25	9.0	90	108	6	1.0	P
.47	35	0.5	5	6	6	12.0	B
1.0	35	0.5	5	6	6	6.0	L
1.5	35	0.6	6	8	6	5.0	U
2.2	35	0.8	8	10	6	3.5	E
3.3	35	1.0	10	12	6	2.5	C
4.7	35	1.7	17	20	6	2.5	H
6.8	35	2.4	24	29	6	2.0	H
10	35	4.0	40	48	6	2.0	I
15	35	6.0	60	72	6	2.0	P

Application Notes

AC Power Dissipation

Case Code	Maximum Power Dissipation in Watts Ambient Temperature		
	+25°C	+85°C	+125°C
B	.063	.056	.025
L	.075	.067	.030
U	.081	.073	.032
E	.095	.085	.038
C	.100	.090	.040
H	.125	.112	.050
I	.150	.135	.060
P	.200	.180	.080

Major physical factors which limit the ability of the capacitor to dissipate internally generated heat produced during AC circuit operation, include unit construction features as related to a particular capacitor design, and heat transfer characteristics of the materials used in the construction of the capacitor. Larger volumetric packages exhibiting electrical characteristics similar to those of smaller physical packages will, under similar conditions, be capable of dissipating more power. Conformally coated capacitors, such as the EXTENDED RANGE series, exhibit more efficient heat dissipation capabilities, due to the absence of relatively thick thermally insulative coatings, as incorporated in "molded" tantalum chip capacitor styles.

Maximum power dissipation levels shown represent an empirically determined wattage level required to cause a 10 degree centigrade temperature increase above the stated temperature in "still air" as measured on the external capacitor body, utilizing a thermo-couple or other appropriate measuring device.

AC Ripple Current

Circuit design and physical layout should provide "cool" circuit board locations for capacitors operating at high AC current levels. Capacitor temperature may increase due to heat transfer or absorption from the ambient environment or a "hot" component mounted in close proximity to the capacitor. The result of increased AC current is increased internal heat generation within the capacitor body. Waveform envelope is also a factor in the amount of internal heat generated within the capacitor since non-sinusoidal waveshapes produce heating effects different than those of sinusoidal waveforms.

The ripple current and voltage level impressed across the capacitor should not exceed the maximum power dissipation of the capacitor unless special provisions are made to increase the rate of heat dissipation from the body of the capacitor, such as by the use of a heat sink or providing air flow. Excessive power dissipation in tantalum chip capacitors may cause catastrophic failure. The I_{max} value of current must be used to determine the operating conditions.

The maximum permissible AC (rms) current applied across the capacitor is related to the equivalent series resistance (ESR) and the physical power dissipation capability of the capacitor. The maximum (rms) ripple current at a given frequency may be determined by:

$$I_{max}\ (\text{rms}) = \sqrt{Pdm/ESR}$$

where. . .Pdm = Maximum Power Dissipation in watts, at the maximum circuit operating temperature

$$ESR = \frac{D.F.}{2\pi * \text{AC Frequency} * \text{Capacitance}}$$

AC Frequency is in Hertz
Capacitance is in Farads
Dissipation Factor is in decimal form

AC Ripple Voltage

The maximum AC ripple voltage at the applied frequency must be limited to an rms value which permits only the recommended maximum power dissipation specified for a given case code. The maximum AC ripple voltage may be determined by:

$$E_r\ (\text{rms}) = Z\sqrt{Pdm/ESR}$$

where. . .E_r = AC Ripple Voltage Z is the Impedance in ohms Pdm is the Maximum Power Dissipation in watts, at the maximum circuit operating temperature
ESR is the Equivalent Series Resistance in ohms

Both voltage and current levels at a given frequency must be maintained so as not to exceed the recommended maximum power dissipation levels at the maximum circuit operating temperature. The DC bias voltage applied in series with the AC source applied across polar style capacitors, on which the AC voltage is "riding", may be ignored when considering the heating effects of AC current on the capacitor. The positive peak AC voltage plus the DC voltage must not exceed the rated DC voltage of the capacitor. The negative peak AC voltage in combination with the DC voltage may not obtain a level which will damage the dielectric due to reverse voltage being applied across a polar solid electrolyte tantalum chip capacitor.

Reverse Voltage

Series 49EC hybrid capacitor will withstand momentary voltage reversals up to 15% at 25°C, 10% at 55°C and 1% at 125°C of the capacitor's rated voltage.

Polarity

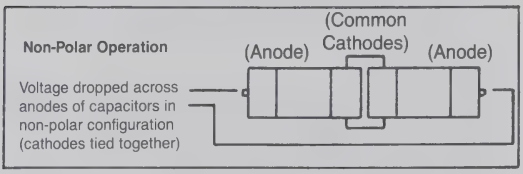
Series 49EC capacitors are polar devices intended for applications involving D.C. circuits. Proper polarity must be observed or damage to the capacitor and/or the circuit will result. Polarity is indicated, when looking at the non-mounting (top) surface, by the bare metal terminal on the positive end.

Voltage Derating-Reliability

At normal operating temperatures, 49 EC capacitors can be operated at less than rated voltage with a proportionate increase in reliability and no degradation of capacitor electrical parameters.

Non-Polar Configuration

In circuits where voltage reversals exceeding 15% at 25°C occur, or where AC ripple voltages are high, 49EC capacitors should be mounted in pairs in a cathode to cathode arrangement to effect non-polar operation.



In these cases, if two identical capacitors are mounted back to back, the resulting capacitance will be 1/2 the value of the original devices and the voltage rating will be the same as the rating of the original devices. The positive peak AC voltage plus the DC voltage must not exceed the rated voltage of the capacitor in either direction.

Handling

Manual: The use of vacuum pencils or plastic tipped tweezers is recommended. Specify 'Blister-Pack' packaging.

Automatic: Because 49EC capacitors are physically rugged, they can be automatically dispensed by vibration type feed bowls (specify 'Blister-Pack' packaging) or by automatic tape fed placement equipment (specify Tape & Reel packaging). Other types of packaging (as specified by customer) will be considered.

Mounting Materials

Most hybrid circuits use various materials in the substrate and pads which have differing coefficients of expansion. Therefore, Philips Components has designed its 49EC to be compatible with solder, epoxy and thermal compression bonding based upon the type termination specified. The "U" shaped termination and method of attachment isolates the capacitor from the substrate, making the 49EC totally compatible with all substrate materials, regardless of thermal mismatch.

Both conductive adhesives and solder pastes or creams lend themselves to production techniques because they can be accurately and rapidly screened onto the pads using masks. They also have a pre-cure tackiness permitting chip placement prior to curing.

Conductive adhesives have the advantage of lower temperature cure mechanisms than those required for solder attachment. They do not require post attachment cleaning and defluxing cycles. Conductivity and joint strength will vary widely depending on the adhesive formulation and curing profile.

Soft metal solder attachment allows the widest latitude of conditions while still providing satisfactory attachment. While optimum joint strength and a low resistance connection are obtained, soldering does require a complex cleaning sequence to remove all traces of fluxes and any entrained contaminants.

The 49EC termination materials are totally compatible with all soft metal solders which provide optimum joint strength over wide temperature excursions and all commercially available fluxing systems. Either water or solvent based fluxing systems may be used.

Mounting Techniques

Wire Bonding The 49EC's standard termination finish, of soft gold plated over a .005″ nickel clip, provides the optimum surface for either thermal compression or ultrasonic wire bonding. Gold plated terminations must be specified for these applications. In a typical application, the chip is glued down "on its back" with the mounting side up, and two wires (repetitive connections) are bonded to each of the positive and negative terminations.

Conductive Adhesive For mounting with conductive adhesive, gold plated terminations are recommended. (A cautionary note when working with conductive adhesives: curing the adhesive at the lowest acceptable temperature for a longer time will minimize the possibility of forming "hairline" cracks in the adhesive during the cure.)

Solder Attach For mounting by means of reflow soldering, 60/40 solder dipped terminations should be specified. The exception to soft metal soldering is the use of Indium/Lead solder, in which case gold plated terminations should be specified. Any of the methods of solder reflow currently in use in the industry may be used with 49EC capacitors.

Hand Soldering It is difficult to control soldering conditions when applying heat with a soldering iron. The solder dipped 49EC capacitor is recommended because the only requirement is to melt the solder of the termination rather than raise the temperature high enough to make a metallurgical bond to the base metal. A 600°F chisel tip iron is recommended, with application of the tip to the interface between the chip termination and the substrate pad. By minimizing the time necessary to reflow the solder, a minimum of heat is transferred to the capacitor body.

Hot Plate This method has advantages over hand soldering for small quantity assembly operations. The temperature is easily controlled and all terminations are reflowed simultaneously. A reflow temperature of 230°C is recommended for alumina substrates. Higher temperatures or longer durations may be required for other substrate material. Preheating to 160°C prior to reflow will provide proper fluxing activation. Room temperature "cool-down" is all that is necessary.

Belt Reflow The advantages of this method is that it provides a uniform increase in temperature to properly activate the fluxing system prior to reflow. The setting of the temperature will depend on the mass being reflowed. The belt speed and heat source should be adjusted or alignment of components should be such that one termination of any component does not reach liquidus temperature before the other. The capillary action or surface tension of the liquid solder could pull the component askew on the pads.

Infra-Red (IR) The same recommendations apply to IR soldering as Belt Reflow with an additional caution that reflective surfaces will have an effect on heat absorption.

Wave Soldering The same recommendations as above apply to this reflow method. Additionally, pre-heating prior to immersing the capacitors in liquid solder has to be considered a necessity rather than a recommendation in order to ensure proper flux activation. Gluing of the device to the substrate is normally required prior to wave soldering.

Vapor Phase The design and construction of the 49EC and its ability to withstand longer durations at higher temperatures make it better suited for vapor phase reflow than other styles of tantalum chip construction. 49EC capacitors will withstand the rapid rise to temperature inherent in the vapor phase system. The solid metal terminations will not de-wet.

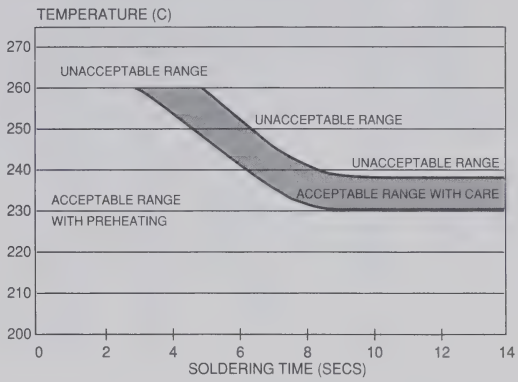
Cleaning

The fluoroelastomer conformal coating prevents intrusion of any contaminates present in the cleaning process. It is compatible with most commonly used cleaning methods and solvents. This includes methods such as ultrasonic, hot and cold solvent sprays, vapor degreasing and detergent washes. All commercially available, commonly used solvents are compatible with the 49EC family of capacitors.

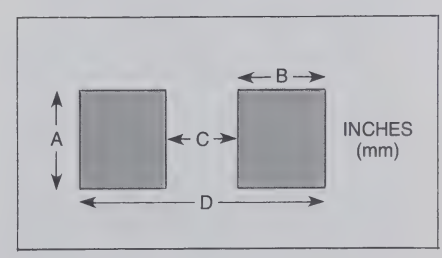
Soldering Profiles for Reflow

Soldering time and temperature should be kept to the minimum required for a good connection. Wave soldering can be very suitably performed at 230–250 degrees C over a period of 3–5 seconds. Infrared or vapor phase techniques should refer to the profile shown below. This profile ensures that the peak reflow and dwell time range does not allow the internal construction to exceed 220 degrees C. A maximum of 150 degrees C with a 10 minute dwell is recommended for the preheating profile. Slight parametric shifts in performance of the devices may be noted immediately following reflow. For this reason, it is recommended that a brief period of stabilization occur at ambient temperature prior to any electrical testing.

Recommended Reflow Time and Temperature



Physical Statistics					Typical Weight (grams)
Case Code	Substrate Area sq. in.	sq. cm.	Typical Volume cu in.	cu. cm.	
B	0.00500	0.0323	0.000250	0.0041	0.02
L	0.00750	0.0484	0.000375	0.0062	0.03
U	0.01000	0.0645	0.000500	0.0082	0.04
E	0.01500	0.0967	0.000750	0.0123	0.07
C	0.02000	0.1290	0.001000	0.0164	0.09
H	0.02970	0.1930	0.001800	0.0295	0.21
I	0.02915	0.1880	0.003200	0.0524	0.33
P	0.04275	0.2760	0.004700	0.0770	0.50



(see dimensions on next page)

Recommended Pad Dimensions for Wave Soldering

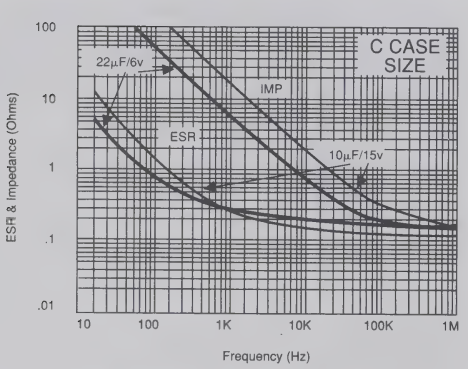
Case Size	A Min.	B Min.	C Nom.	D Nom.
B	.044 (1.11)	.067 (1.58)	.030 (0.77)	.204 (5.17)
L	.044 (1.11)	.067 (1.58)	.080 (2.04)	.254 (6.44)
U	.044 (1.11)	.067 (1.70)	.130 (3.31)	.304 (6.44)
E	.077 (1.96)	.067 (1.70)	.080 (2.04)	.254 (7.71)
C	.077 (1.96)	.067 (1.70)	.130 (3.31)	.304 (7.71)
H	.101 (2.55)	.067 (1.70)	.150 (3.82)	.324 (8.22)
I	.084 (2.13)	.087 (2.21)	.155 (3.94)	.369 (9.36)
P	.111 (2.81)	.087 (2.21)	.175 (4.45)	.389 (9.88)

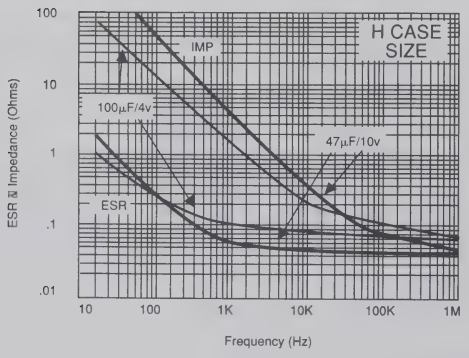
Recommended Pad Dimensions for Reflow Soldering

Case Size	A Min.	B Min.	C Nom.	D Nom.
B	.085 (2.15)	.062 (1.58)	.030 (0.77)	.204 (5.17)
L	.085 (2.15)	.062 (1.58)	.080 (2.04)	.254 (6.44)
U	.085 (2.15)	.062 (1.58)	.130 (3.31)	.304 (7.71)
E	.135 (3.42)	.062 (1.58)	.080 (2.04)	.254 (6.44)
C	.135 (3.42)	.062 (1.58)	.130 (3.31)	.304 (7.71)
H	.170 (4.31)	.062 (1.58)	.150 (3.82)	.324 (8.22)
I	.145 (3.67)	.082 (2.08)	.155 (3.94)	.369 (9.36)
P	.185 (4.45)	.082 (2.08)	.175 (4.45)	.389 (9.88)

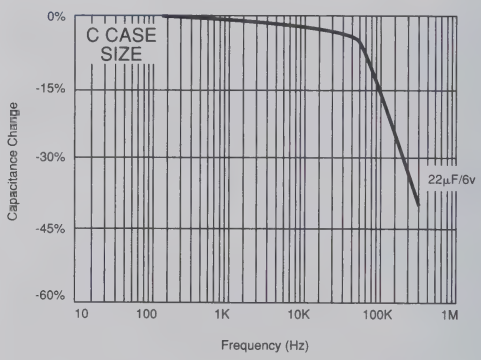
Typical Characteristics

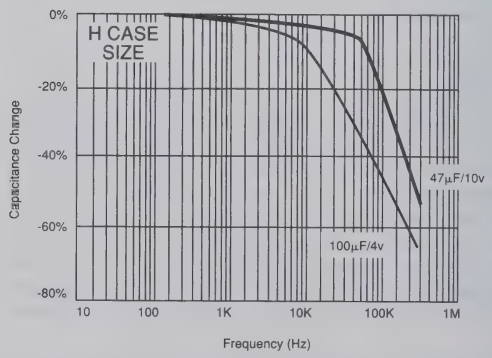
ESR & Impedance vs Frequency





Capacitance Change vs Frequency

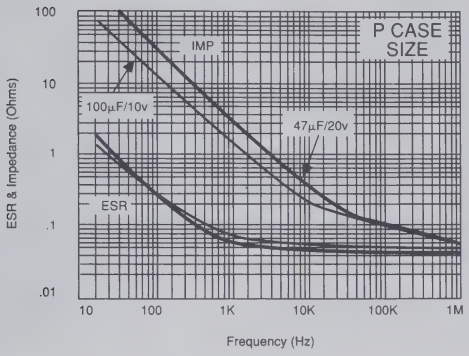




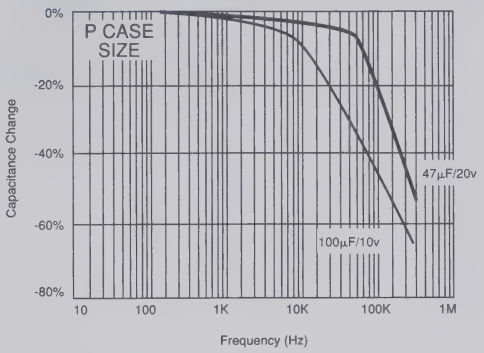
Philips Components 1440 W. Indiantown Road, Jupiter, FL 33458 (407) 744-4200

Typical Characteristics

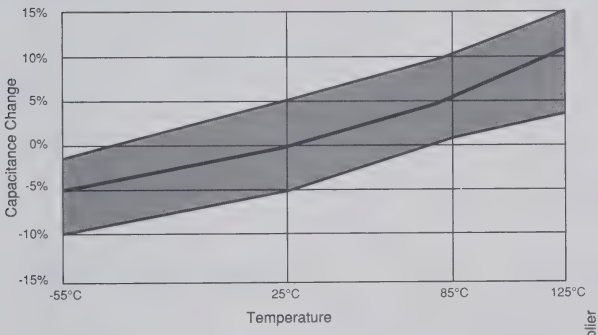
ESR & Impedance vs Frequency



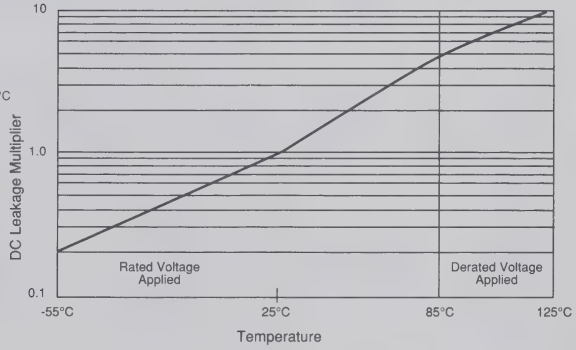
Capacitance Change vs Frequency



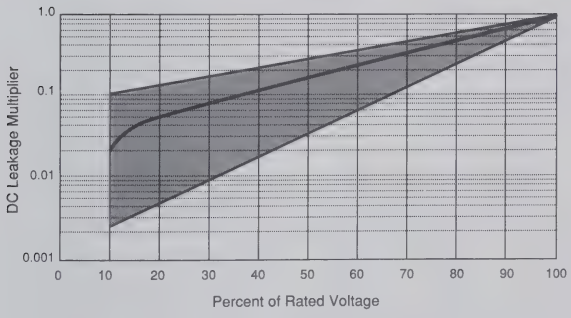
Typical Effect of Temperature on Capacitance

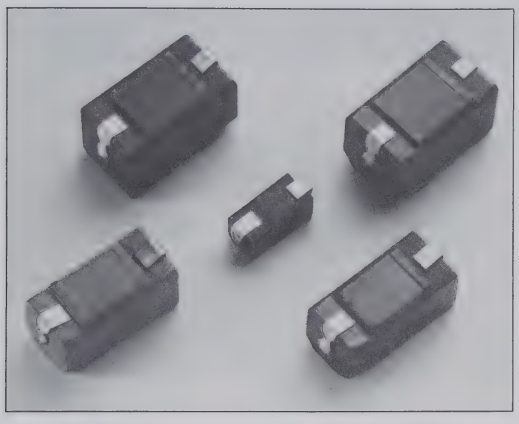


Typical Effect of Temperature on DC Leakage



Typical Range of DC Leakage as a Function of Applied Voltage





Aluminum Electrolytic SMD® Capacitors Series CLL 139

Applications

- SMD technology, low mounting height
- Industrial and professional applications
- Telecommunications, automotive, control, data processing
- Coupling, decoupling, smoothing, filtering, buffering, timing.

Features

- Polarized Aluminium electrolytic capacitors, non-solid electrolyte, self healing
- Miniaturized, high CV per unit volume, extended voltage range
- SMD-version, fully moulded, insulated
- Flexible terminals, reflow and wave solderable
- Compact, rectangular shape, low height
- Charge and discharge proof, no current limitation.

Quick Reference Data

Parameter	Case Size (l × w × h in mm)	
	10.8 × 4.1 × 4.4 and 13.8 × 4.1 × 4.4	**14.3 × 6.2 × 6.9 and 14.3 × 7.6 × 8.2**
Nominal capacitance range, C_{nom}:	0.22 to 220 uF	
Tolerance on C_{nom}:	± 20%	
Rated voltage range, U_R:	6.3 to 100 V	
Category temperature range:	−40 to +105°C	−55 to +105°C
Endurance test at 105°C:	1000 hours	
Useful life at 105°C: Useful life at 40°C; 1.3 × I_R applied:	2000 hours 200 000 hours	
Shelf life at 0 V, 105°C:	500 hours	
Resistance to soldering heat test:	immersion in solder: 10 seconds at 260°C or 40 seconds at 215°C	
Basic specifications:	IEC 384-4 L.L. grade similar to DIN 41316	
Climatic category IEC 68: Climatic category DIN 40040:	40/105/56 GMF	55/105/56 FMF

Table 1 Selection chart for C_{nom} U_R and relevant nominal case sizes (l × w × h in mm).

C_{nom} (µ)	U_R (V)								
	6.3	10	16	25	40	50	63		100
0.22							10.8 × 4.1 × 4.4	14.3 × 6.2 × 6.9	14.3 × 6.2 × 6.9
0.47							10.8 × 4.1 × 4.4	14.3 × 6.2 × 6.9	14.3 × 6.2 × 6.9
1							10.8 × 4.1 × 4.4	14.3 × 6.2 × 6.9	14.3 × 6.2 × 6.9
1.5						10.8 × 4.1 × 4.4	13.8 × 4.1 × 4.4	14.3 × 6.2 × 6.9	
2.2					10.8 × 4.1 × 4.4		13.8 × 4.1 × 4.4	14.3 × 6.2 × 6.9	14.3 × 6.2 × 6.9
3.3				10.8 × 4.1 × 4.4		13.8 × 4.1 × 4.4	14.3 × 6.2 × 6.9		14.3 × 7.6 × 8.2
4.7			10.8 × 4.1 × 4.4		13.8 × 4.1 × 4.4		14.3 × 6.2 × 6.9		14.3 × 7.6 × 8.2
6.8		10.8 × 4.1 × 4.4		13.8 × 4.1 × 4.4		14.3 × 6.2 × 6.9	14.3 × 7.6 × 8.2		
10	10.8 × 4.1 × 4.4		13.8 × 4.1 × 4.4	14.3 × 6.2 × 6.9		14.3 × 6.2 × 6.9	14.3 × 7.6 × 8.2		
15		13.8 × 4.1 × 4.4			14.3 × 6.2 × 6.9	14.3 × 7.6 × 8.2			
22	13.8 × 4.1 × 4.4		14.3 × 6.2 × 6.9	14.3 × 6.2 × 6.9		14.3 × 7.6 × 8.2			
33		14.3 × 6.2 × 6.9		14.3 × 6.2 × 6.9	14.3 × 7.6 × 8.2				
47	14.3 × 6.2 × 6.9		14.3 × 6.2 × 6.9	14.3 × 7.6 × 8.2					
68		14.3 × 6.2 × 6.9							
100	14.3 × 6.2 × 6.9		14.3 × 7.6 × 8.2						
150		14.3 × 7.6 × 8.2							
220	14.3 × 7.6 × 8.2								

Mechanical Data Dimensions (in mm)

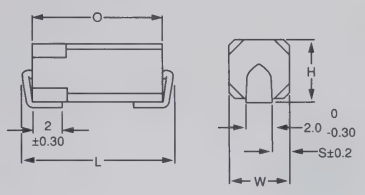


Fig. 2 Case sizes
10.8 × 4.1 × 4.4 and 13.8 × 4.1 × 4.4

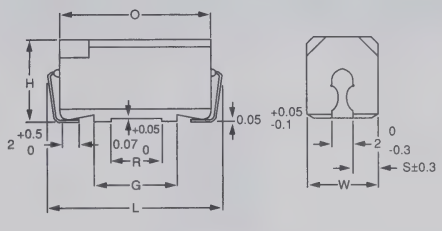


Fig. 3 Case sizes
14.3 × 6.2 × 6.9 and 14.3 × 7.6 × 8.2

Table 2

Case Size	Case Code	L max.	W max.	H max.	O max.	S	G max.	R min.	Mass (g)
10.8 × 4.1 × 4.4	1a	11.0	4.2	4.5	9.6	1.10	—	—	0.3
13.8 × 4.1 × 4.4	1	14.0	4.2	4.5	12.6	1.10	—	—	0.65
14.3 × 6.2 × 6.9	2	14.5	6.3	7.05	13.0	2.15	7.5	4.7	0.95
14.3 × 7.6 × 8.2	3	14.5	7.7	8.35	13.0	2.85	7.5	4.7	1.3

Marking

Case sizes
14.3 × 6.2 × 6.9 and 14.3 × 7.6 × 8.2 mm

- Nominal capacitance (in μF)
- Rated voltage (in V)
- Series number (139)
- Name of manufacturer
- Date code (year and month) in accordance with IEC 62
- .-" sign indicating the cathode (bevelled edges identify the anode).

Case sizes
10.8 × 4.1 × 4.4 and 13.8 × 4.1 × 4.4 mm

- Nominal capacitance (in μF)
- Rated voltage code (see Table 3), the U_R code letter indicates the position of the decimal point in the capacitance value
- Name of manufacturer
- Date code (year and month) in accordance with IEC 62
- .-" sign indicating the cathode (bevelled edges identify the anode).

EXAMPLES For CNOM - U_R Marking:
H22 represents 0.22 μF - 63 V
2G2 represents 2.2 μF - 40 V
22C represents 22 μF - 6.3 V

Table 3 Rated voltage marking code

U_R (V)	6.3	10	16	25	40	50	63	100
code letter	C	D	E	F	G	A	H	I

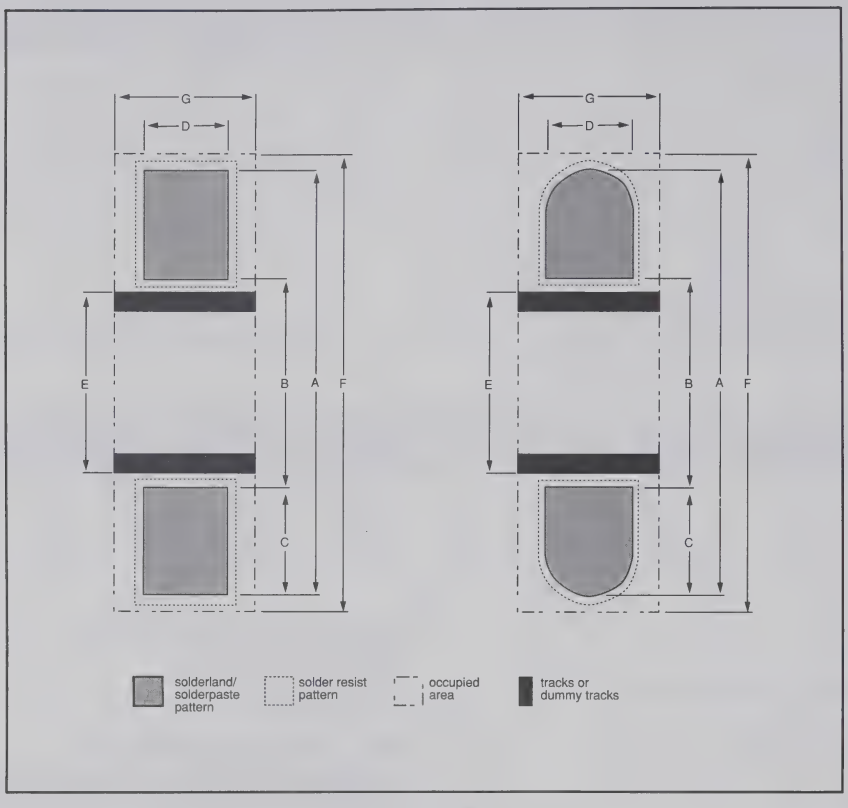


Fig. 4 Recommended pad dimensions for reflow and wave soldering.

Table 4 Recommended soldering pad dimensions in mm. (placement accuracy ±0.25 mm)

Case Size	For Reflow Soldering							For Wave Soldering						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G
10.8 × 4.1 × 4.4	11.8	4.8	3.5	2.5	4.0	12.2	5.3	14.5	6.5	4.0	3.5	5.3	15.0	8.5
13.8 × 4.1 × 4.4	14.8	7.8	3.5	2.5	7.0	15.2	5.3	17.5	9.5	4.0	3.5	8.3	18.0	8.5
14.3 × 6.2 × 6.9	15.8	8.8	3.5	2.8	8.0	16.2	7.7	18.6	10.0	4.3	5.0	8.8	20.5	11.5
14.3 × 7.6 × 8.2	15.8	8.8	3.5	2.8	8.0	16.2	9.1	18.6	10.0	4.3	6.0	8.8	21.5	13.0

Mounting

The capacitors are designed for automatic placement on to printed-circuit boards or hybrid circuits.

Optimum dimensions of soldering pads depend amongst others on soldering method, mounting accuracy, print lay-out and/or adjacent components.

For recommended dimensions, refer to Fig. 4 and Table 4.

Soldering

Soldering conditions are defined by the curve temperature versus time, at which the temperature is that measured on the soldering pad during processing.

For maximum conditions of different soldering methods see Figs. 5, 6 and 7.

Any temperature vs. time curve may be applied which does not exceed the specified maximum curves.

Maximum temperature load

Table 5 Curing conditions for SMD-glue

Max. T_{amb} (°C)	Max. Exposure Time (minutes)
125	30
140	10
150	5
160	2

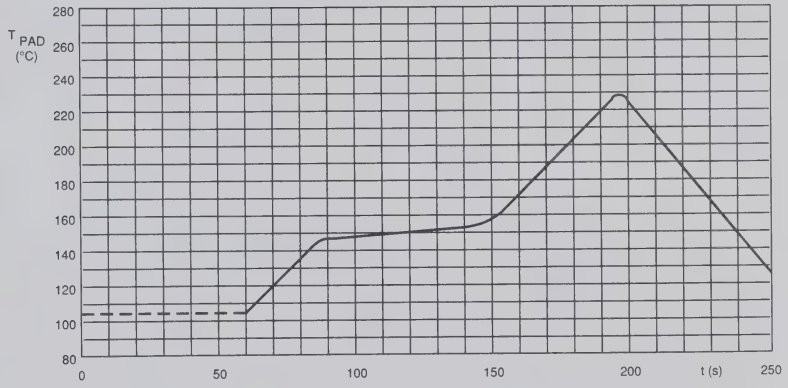


Fig. 5 Max. temperature load during infrared reflow soldering.

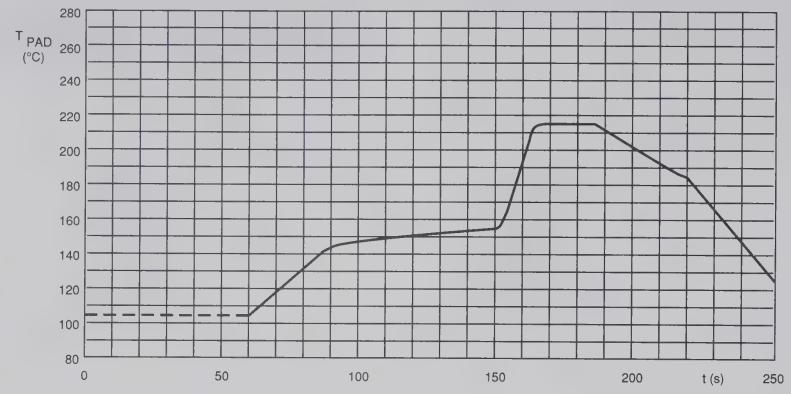


Fig. 6 Max. temperature load during vapor phase reflow soldering.

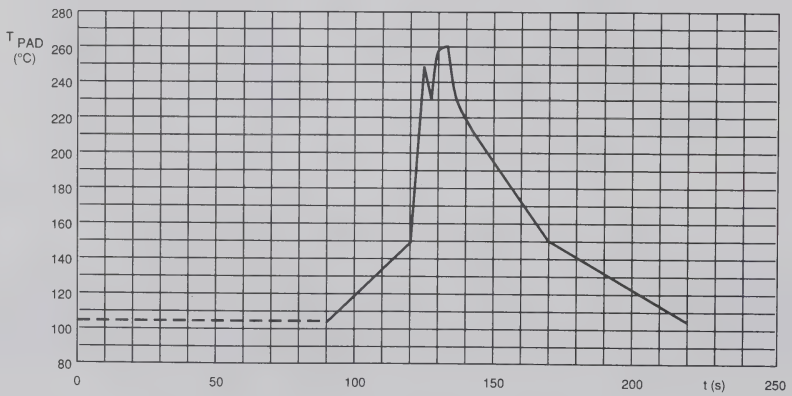


Fig. 7 Max. temperature load during (double-) wave soldering.

Electrical Data and Ordering Information

Unless otherwise specified, all electrical values in Table 6 apply at Ta = 20°C, Pa = 86 to 106 kPa, RH = 45 to 75%.

C_{nom} = nominal capacitance at 120 Hz, tolerance ± 20%
I_R = rated RMS ripple current at 120 Hz, 105°C

I_{L1} = max. DC leakage current after 1 min. at U_R
I_{L5} = max. DC leakage current after 5 min. at U_R
tan δ = max. dissipation factor at 120 Hz
ESR = equivalent series resistance at 120 Hz (calculated from tan δ max. and C_{nom}).
Z = max. impedance at 10 kHz

Table 6 Electrical data

U_R (V)	C_{nom} 120 Hz (μF)	Nominal Case Size L × W × H (mm)	I_R 105°C (mA)	I_{L1} 1 min. (μA)	I_{L5} 5 min. (μA)	tan δ 120 Hz	ESR 120 Hz (Ω)	Z 10 kHz (Ω)	Catalogue Number 2222 .....
6.3	10	10.8 × 4.1 × 4.4	13	4	3.1	0.30	48	20.0	139 63109
	22	13.8 × 4.1 × 4.4	25	6	3.3	0.30	22	9.0	139 63229
	47	14.3 × 6.2 × 6.9	62	9	3.6	0.16	5.4	6.4	139 63479
	100	14.3 × 6.2 × 6.9	79	16	4.3	0.24	3.8	3.0	139 63101
	220	14.3 × 7.6 × 8.2	120	32	5.8	0.24	1.7	1.4	139 63221
10	6.8	10.8 × 4.1 × 4.4	13	5	3.1	0.25	59	24.0	139 64688
	15	13.8 × 4.1 × 4.4	23	6	3.3	0.25	27	11.0	139 64159
	33	14.3 × 6.2 × 6.9	59	10	3.7	0.14	6.8	6.1	139 64339
	68	14.3 × 6.2 × 6.9	71	17	4.4	0.20	4.7	2.9	139 64689
	150	14.3 × 7.6 × 8.2	110	33	6.0	0.20	2.1	1.3	139 64151
16	4.7	10.8 × 4.1 × 4.4	12	5	3.2	0.20	68	26.0	139 65478
	10	13.8 × 4.1 × 4.4	21	6	3.3	0.20	32	12.0	139 65109
	22	14.3 × 6.2 × 6.9	52	10	3.7	0.12	8.7	7.3	139 65229
	47	14.3 × 6.2 × 6.9	66	18	4.5	0.16	5.4	3.4	139 65479
	100	14.3 × 7.6 × 8.2	100	35	6.2	0.16	2.5	1.6	139 65101
25	3.3	10.8 × 4.1 × 4.4	11	5	3.2	0.18	87	27.0	139 66338
	6.8	13.8 × 4.1 × 4.4	18	6	3.3	0.18	42	13.0	139 66688
	10	14.3 × 6.2 × 6.9	40	8	3.5	0.09	14	12	139 66109
	22	14.3 × 6.2 × 6.9	48	14	4.1	0.14	10	5.5	139 66229
	33	14.3 × 6.2 × 6.9	59	19	4.7	0.14	6.8	3.7	139 66339
	47	14.3 × 7.6 × 8.2	79	27	5.4	0.14	4.7	2.6	139 66479
40	2.2	10.8 × 4.1 × 4.4	9	5	3.2	0.16	120	32.0	139 67228
	4.7	13.8 × 4.1 × 4.4	16	7	3.4	0.16	54	15.0	139 67478
	15	14.3 × 6.2 × 6.9	45	15	4.2	0.11	12	6	139 67159
	33	14.3 × 7.6 × 8.2	75	29	5.6	0.11	5.3	2.7	139 67339

Table 6 *continued*

U_R (V)	C_{nom} 120 Hz (μF)	Nominal Case Size L × W × H (mm)	I_R 105°C (mA)	I_{L1} 1 min. (μA)	I_{L5} 5 min. (μA)	tan δ 120 Hz	ESR 120 Hz (Ω)	Z 10 kHz (Ω)	CATALOGUE NUMBER 2222 ... .
50	1.5	10.8 × 4.1 × 4.4	8	5	3.2	0.15	160	40.0	139 61158
	3.3	13.8 × 4.1 × 4.4	14	7	3.3	0.15	72	14.0	139 61338
	6.8	14.3 × 6.2 × 6.9	33	10	3.7	0.09	21	10	139 61688
	10	14.3 × 6.2 × 6.9	40	13	4.0	0.09	14	7	139 61109
	15	14.3 × 7.6 × 8.2	56	18	4.5	0.09	9.5	4.7	139 61159
	22	14.3 × 7.6 × 8.2	67	25	5.2	0.09	6.5	3.2	139 61229
63	0.22	10.8 × 4.1 × 4.4	2.5	4	3.0	0.10	720	250	139 90012
	0.22	14.3 × 6.2 × 6.9	2.5	4	3.0	0.09	650	160	139 68227
	0.47	10.8 × 4.1 × 4.4	5	4	3.1	0.10	340	117	139 90013
	0.47	14.3 × 6.2 × 6.9	5	4	3.1	0.09	300	95	139 68477
	1	10.8 × 4.1 × 4.4	8	4	3.1	0.12	190	55	139 90014
	1	14.3 × 6.2 × 6.9	11	4	3.1	0.09	140	55	139 68108
	1.5	13.8 × 4.1 × 4.4	10	5	3.2	0.14	150	37	139 90015
	1.5	14.3 × 6.2 × 6.9	15	5	3.2	0.09	95	37	139 68158
	2.2	13.8 × 4.1 × 4.4	12	6	3.3	0.14	100	25	139 90016
	2.2	14.3 × 6.2 × 6.9	19	6	3.3	0.09	65	25	139 68228
	3.3	14.3 × 6.2 × 6.9	23	7	3.4	0.09	43	21	139 68338
	4.7	14.3 × 6.2 × 6.9	28	9	3.6	0.09	30	17	139 68478
	6.8	14.3 × 7.6 × 8.2	40	12	3.9	0.08	19	11	139 68688
	10	14.3 × 7.6 × 8.2	48	16	4.3	0.08	13	8	139 68109
100	0.22	14.3 × 6.2 × 6.9	4	4	3.0	0.09	650	160	139 69227
	0.47	14.3 × 6.2 × 6.9	8	4	3.1	0.09	300	95	139 69477
	1.0	14.3 × 6.2 × 6.9	12	5	3.2	0.09	140	55	139 69108
	2.2	14.3 × 6.2 × 6.9	19	7	3.4	0.09	65	29	139 69228
	3.3	14.3 × 7.6 × 8.2	27	10	3.7	0.08	39	17	139 69338
	4.7	14.3 × 7.6 × 8.2	33	12	3.9	0.08	27	11	139 69478

Voltage

Surge voltage for short periods $U_s \leq 1.15 \times U_R$

Reverse voltage for short periods $U_{rev} \leq 1$ V

Leakage current

After 1 min at U_R $I_{L1} \leq 0.02\ C_{nom}\ U_R + 3\ \mu A$

After 5 min at U_R $I_{L5} \leq 0.002\ C_{nom}\ U_R + 3\ \mu A$

Capacitance

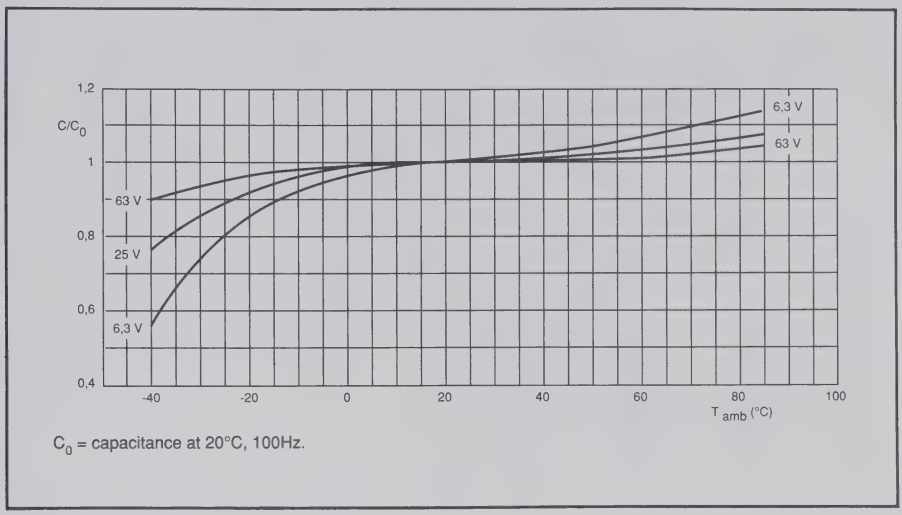


Fig. 8 Multiplier of capacitance (C/C_0) as a function of ambient temperature; C_0 = capacitance at 20°C, 120 Hz; case sizes 10.8 × 4.1 × 4.4 and 13.8 × 4.1 × 4.4.

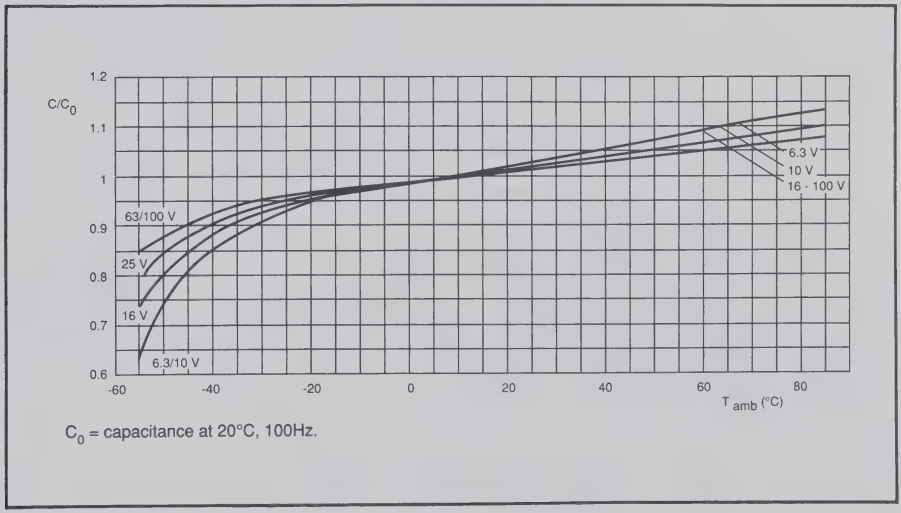


Fig. 9 Multiplier of capacitance (C/C_0) as a function of ambient temperature; C_0 = capacitance at 20°C, 120 Hz; case sizes 14.3 × 6.2 × 6.9 and 14.3 × 7.6 × 8.2.

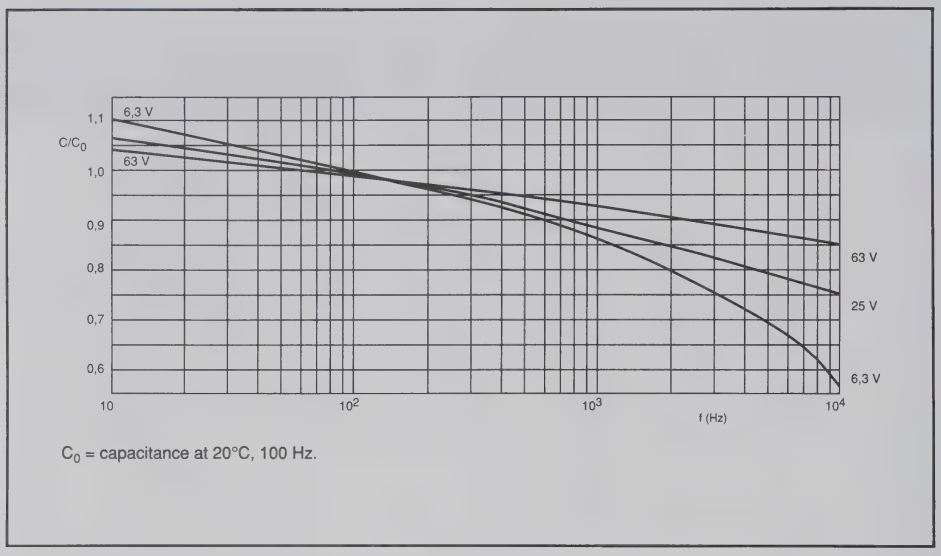


Fig. 10 Multiplier of capacitance (C/C_o) as a function of frequency; C_o = capacitance at 20°C, 120 Hz; case sizes 10.8 × 4.1 × 4.4 and 13.8 × 4.1 × 4.4

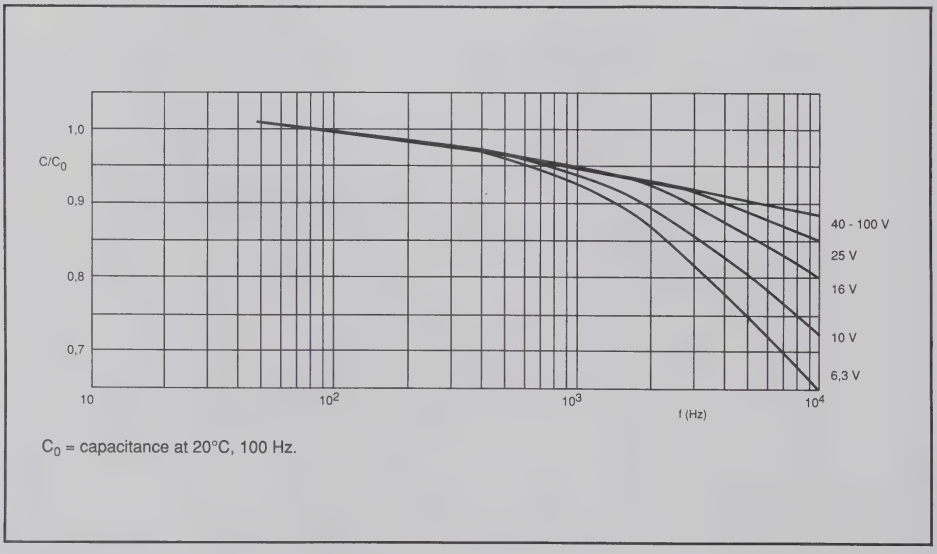


Fig. 11 Multiplier of capacitance (C/C_o) as a function of frequency; C_o = capacitance at 20°C, 120 Hz; case sizes 14.3 × 6.2 × 6.9 and 14.3 × 7.6 × 8.2.

Equivalent Series Resistance (ESR)

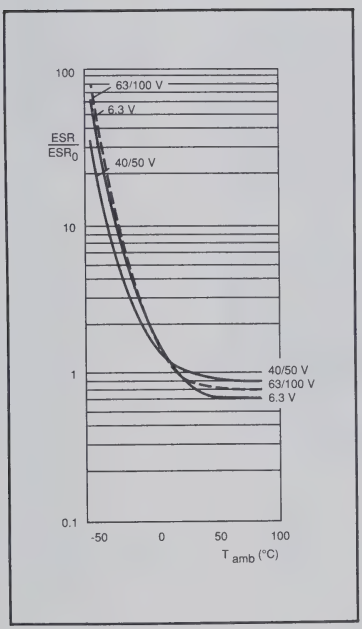


Fig. 12 Multiplier of ESR (ESR/ESR_o) as a function of ambient temperature; ESR_o = typical ESR at 20°C, 120 Hz.

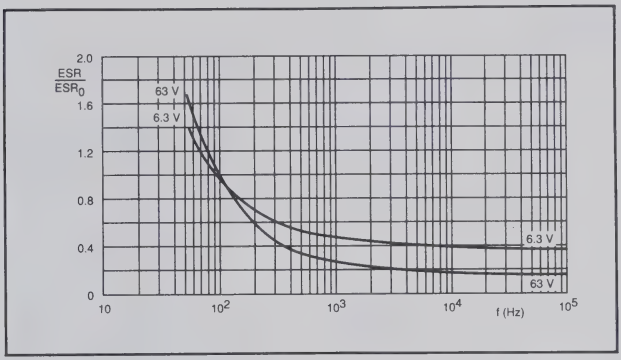


Fig. 13 Multiplier of ESR(ESR/ESR_o) as a function of frequency; ESR_o = typical ESR at 20°C and 120 Hz; case sizes 10.8 × 4.1 × 4.4 and 13.8 × 4.1 × 4.4.

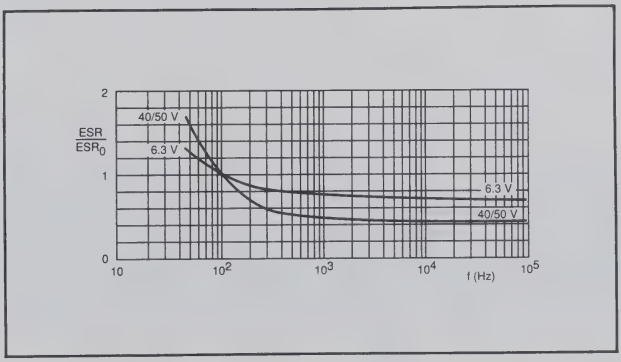


Fig. 14 Multiplier of ESR(ESR/ESR_o) as a function of frequency; ESR_o = typical ESR at 20°C and 120 Hz; case sizes 14.3 × 6.2 × 6.9 and 14.3 × 7.6 × 8.2.

Equivalent Series Inductance (ESL)

case size 10.8 × 4.1 × 4.4	typ. 11 nH
case size 13.8 × 4.1 × 4.4	typ. 13 nH
case size 14.3 × 6.2 × 6.9	typ. 18 nH
case size 14.3 × 7.6 × 8.2	typ. 28 nH

Impedance (Z)

Curve

1 = 2.2 µF, 40 V
2 = 4.7 µF, 40 V
3 = 10 µF, 50 V
4 = 22 µF, 25 V
5 = 47 µF, 25 V
6 = 100 µF, 16 V
7 = 220 µF, 6.3 V

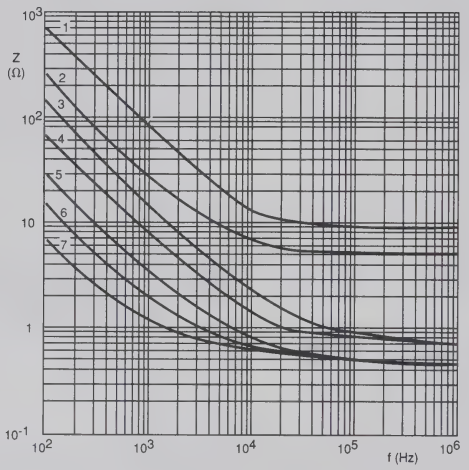
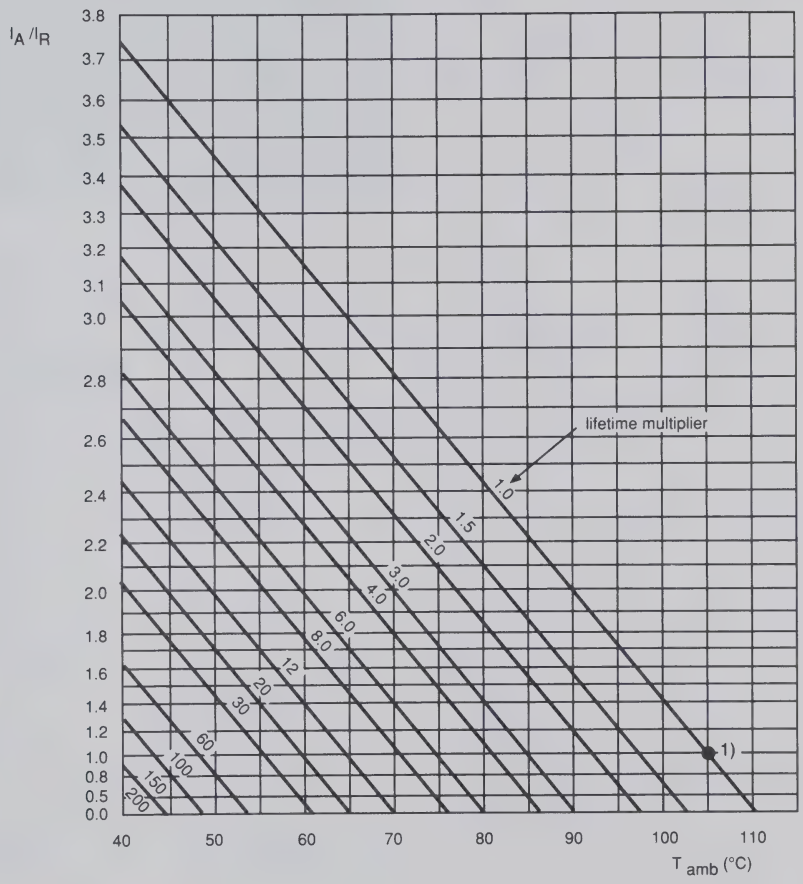


Fig. 15 Typical impedance as a function of frequency at T_{amb} = 20°C.

Ripple Current and Useful Life

Table 7 Multiplier of ripple current (I_R/I_{RO}) as a function of frequency (I_{RO} = rated ripple current at 120 Hz and 105°C)

Freq. (Hz)	I_R/I_{RO}					
	Case Sizes 10.8 × 4.1 × 4.4 and 13.8 × 4.1 × 4.4			Case Sizes 14.3 × 6.2 × 6.9 and 14.3 × 7.6 × 8.2		
	6.3-16	25-50	63-100 V	6.3-16	25-50	63-100 V
60	0.85	0.8	0.75	0.95	0.9	0.85
120	1	1	1	1	1	1
360	1.2	1.35	1.5	1.07	1.12	1.2
1000	1.3	1.6	2	1.12	1.2	1.3
3000	1.35	1.8	2.3	1.15	1.25	1.35
≥ 10 000	1.4	2	2.4	1.2	1.3	1.4



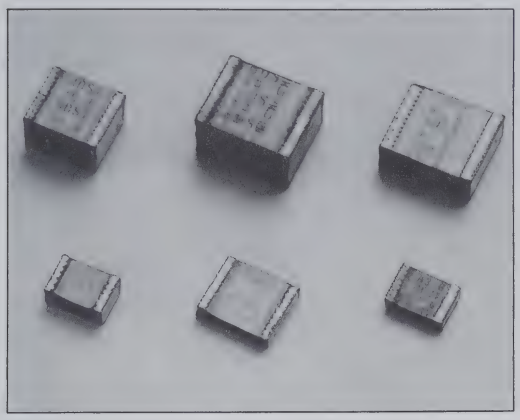
1) Useful life at 105°C, U_R and I_R applied: 2000 hours.

Fig. 16 Useful life as a function of ripple current load (I_R/I_{RO}) and ambient temperature. (I_{RO} = rated ripple current at 120 Hz, 105°C).

Tests and Requirements

Table 8

Test		Procedure (Quick Reference)	Specific Requirements
Name of Test	**Reference**		
Mounting sub clause 4.33	IEC-384-1	to be performed prior to tests mentioned below: method: reflow or (double-) wave soldering for max. temp. load (see) chapter, mounting	$\Delta C/C \leq \pm 5\%$ tan δ ≤ spec. limit I_{L5} ≤ spec limit.
Endurance	IEC 384-4 sub clause 4.13	$T_A = 105°C$, U_R applied 1000 hours	$\Delta C/C$ 6.3 V: +15/−30% 10 to 100 V: +15/−15% tan $\delta \leq 1.3 \times$ spec. limit $Z \leq 2 \times$ spec. limit $I_{L5} \leq$ spec. limit
Useful life	CECC 30 301 amendment, sub clause 1.8.1	$T_A = 105°C$, U_R and I_R applied 2000 hours	$\Delta C/C$ 6.3 V: +45/−50% 10 to 100 V: +45/−45% tan $\delta \leq 3 \times$ spec. limit $Z \leq 3 \times$ spec. limit $I_{L5} \leq$ spec. limit failure percentage ≤ 1%
Shelf life (storage at high temp).	IEC 384-4 sub clause 4.17	$T_A = 105°C$, no voltage applied 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	see Endurance (above)



Metallized Polyphenylene Sulphide Film Capacitors MKPS Chip Capacitor Series 2222 390/394

Features

- Surface Mounted
- Supplied in tape on reel

Quick Reference Data

Rated Capacitance range (E12-series):	0.00047 to 0.47μF
Tolerance on rated capacitance:	$\pm$5%, $\pm$10%
Rated Voltage U_R:	25 VDC/16VAC
Climatic category:	55/125/56
Rated temperature:	100°C
Maximum Application Temperature:	125°C
Tangent of the loss angle at 10 kHz:	25×10^{-4}
Reference specification:	IEC 384-1; 40 (SECR) 644 EN132500 (Draft)
Performance grade:	Grade 2
Rated Storage:	-55°C to $+40$°C, RH $<$ 80% (No condensation)
Packaging:	Blister Tape
Dielectric Absorption:	0.085% (Typical)/JIS C 5112 (MIL-C-19978E)

Style		Size	
2222	394	(2824)	L = 7.2mm
2222	393	(2220)	L = 5.7mm
2222	392	(1812)	L = 4.5mm
*2222	391	(1210)	L = 3.2mm
*2222	390	(1206)	L = 3.2mm

*In development. Contact the factory for availability.

Application

These capacitors with high capacitance per unit volume are for surface mounted assembly. Their dimensions, performance and reliability make them very attractive for a wide range of applications, specially where high package density is required. Typical application areas are e.g. radio, television, camera, pocket calculators, telecommunication and military equipment. The taped versions are especially suitable for automatic placement.

Description

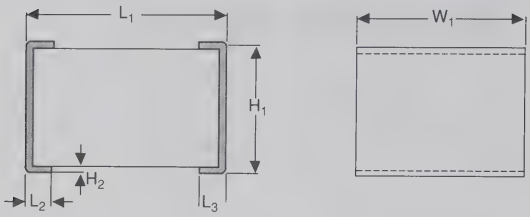
The capacitor consists of stacked metallized non-flammable Polyphenylene Sulphide (PPS) film. The terminations are solder coated. The capacitor can withstand solvents without damage.

Mechanical

(for more detailed specifications, contact Philips Components Columbia, SC)

Dimensions

(all dimensions are given in mm)



Mounting

The capacitors are suited for surface mounting either by hand or by automatic placement. Soldering can be done by means of reflow or solderwave.

Typical marking (when possible)

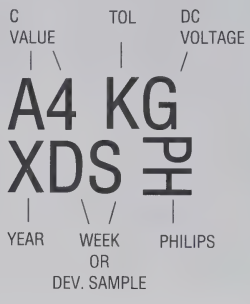


Fig. 1 Physical dimensions (see Table 1).

Table 1 Capacitor dimensions and case size reference

Case Size Reference	Dimensions (mm)				
	L	b	H max	L_1/L_2	H_1
*1206	3.2 ± 0.2	1.6 ± 0.2	1.2	0.7 ± 0.3	0.100 ± 0.05
*1210	3.2 ± 0.2	2.5 ± 0.2	2.0	0.7 ± 0.3	0.100 ± 0.05
1812	4.5 ± 0.2	3.2 ± 0.2	2.5	0.7 ± 0.3	0.100 ± 0.05
2220	5.7 ± 0.3	5.0 ± 0.3	4.0	0.7 ± 0.3	0.100 ± 0.05
2824	7.2 ± 0.2	6.1 ± 0.3	4.8	1.0 ± 0.3	0.100 ± 0.05

*In development. Contact the factory for availability.

Smallest Packing Quantities (SPQ)	Blister-Tape on Reel
Case Sizes	SPQ
1206	3500
1210	3500
1812	3500
2220	2000
2824	1000

Table 2 U_R (DC) = 25V; max. AC voltage = 16V

Capacitance (μF)	Catalogue number 2222						
	390	391	392	393	394	Last Digits of Catalogue Number	
	Case Size						
	1206(*)	1210(*)	1812	2220	2824	C-tol ± 10%	C-tol ± 5%
	h_{max}	h_{max}	h_{max}	h_{max}	h_{max}		
0.00047	1.2					28471	29471
0.00068	1.2					28681	29681
0.0010	1.2	1.4	1.8			28102	29102
0.0015	1.2	1.4	1.8			28152	29152
0.0022	1.2	1.4	1.8			28222	29222
0.0033	1.2	1.4	1.8			28332	29332
0.0047	1.2	1.4	1.8			28472	29472
0.0068		1.4	1.8			28682	29682
0.010		1.4	1.8			28103	29103
0.015		1.8	1.8			28153	29153
0.022			1.8			28223	29223
0.033			1.8	1.8		28333	29333
0.047			2.3	1.8		28473	29473
0.068				1.8		28683	29683
0.10				2.1	1.8	28104	29104
0.15				2.9	1.9	28154	29154
0.22				4.0	2.5	28224	29224
0.33					3.5	28334	29334
0.47					4.8	28474	29474

Example: 12 Digit Number 2222 3 _ _ 2 _ _ _ _
A 0.1μF, 5% capacitor with a 2220 case size, and supplied on tape has a catalogue number of 2222 393 29104.

Electrical

(for more detailed specifications, contact Philips Components Columbia, SC)

I. Capacitance

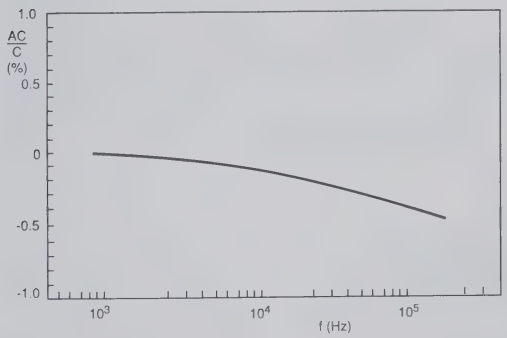
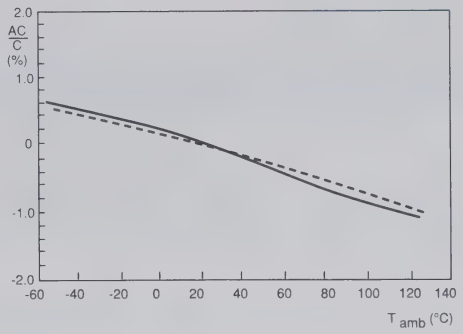


Fig. 1 Capacitance as a function of frequency: typical curve



-------- for all capacitance values, measured at 100 kHz
——— for all capacitance values, measured at 1 kHz

Fig. 2 Capacitance as a function of ambient temperature: typical curve

II. Insulation resistance at T_{amb} = 20°C

The insulation resistance is measured after a voltage has been applied for 1 minute ±5 s, the voltage being 10 ±1V.

R between terminations, for C ≤ 0.33 μF > 3750 MΩ
RC between terminations, for C > 0.33 μF > 1250 sec.

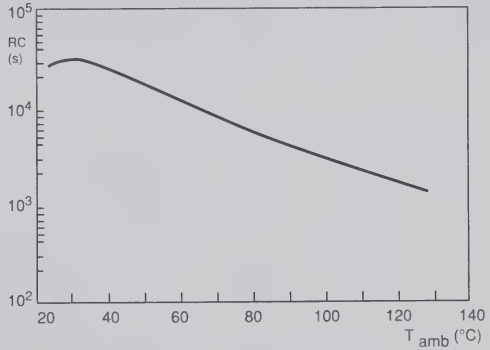


Fig. 3 RC product as a function of ambient temperature: typical curve.

III. Maximum pulse load

Rated voltage V	Maximum pulse load(V/μs)			
	L = 3.2mm	L = 4.5mm	L = 5.7mm	L = 7.2mm
25	40	30	20	15

The maximum pulse load values are valid for pulse voltages equal to the rated voltage. For lower pulse voltages the given values may be multiplied by U_R/applied voltages.

Note:
1. If the pulse load requirement is satisfied, a check must be made to ascertain that the maximum dissipation is not exceeded.
2. The sum of the d.c. voltage and the peak value of the superimposed a.c. voltage must be $\leqq$ the rated d.c. voltage. For other than sinusoidal wave forms, the maximum dissipation must not be exceeded.

IV. Tangent of the loss angle

Capacitance	Tangent of the loss angle		
	at 1 kHz	at 10 kHz	at 100 kHz
$C \leq 0.1\mu F$	$< 20 \times 10^{-4}$	$< 25 \times 10^{-4}$	$< 35 \times 10^{-4}$
$C > 0.1\mu F$	$< 20 \times 10^{-4}$	$< 25 \times 10^{-4}$	$< 50 \times 10^{-4}$

V. Impedance

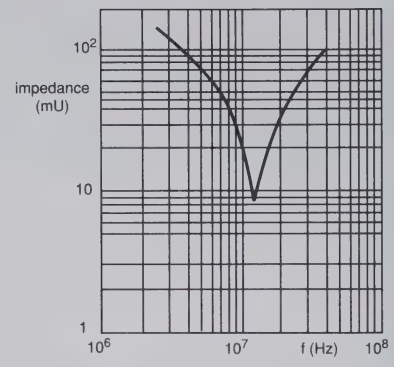


Fig. 5 Impedance as function of frequency: typical curve for 0.047 μF (1812 size).

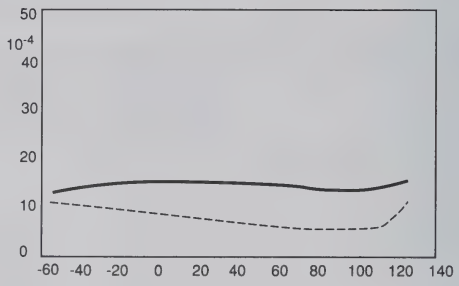
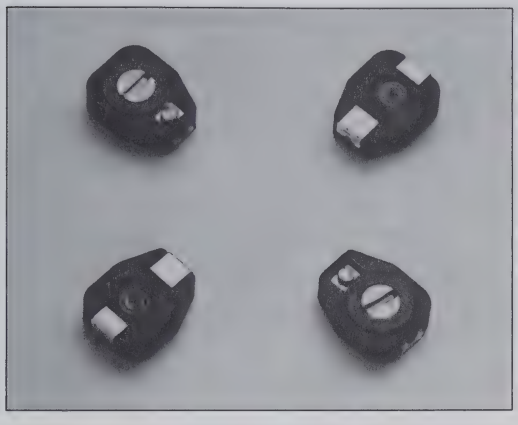


Fig. 4 Tangent of the loss angle as a function of ambient temperature: typical curve.

Properties of Dielectric Films (Typical)

		PPS	PET	PC	PP
Dielectric Constant	1 kHz 25°C	3.0	3.3	3.0	2.2
Dissipation Factor (%)	1 kHz 25°C	0.06	0.2	0.1	0.02
	1 kHz 100°C	0.06	0.4	0.15	0.01
	1 mHz 25°C	0.18	1.0	0.8	0.02
Dielectric Strength (V/um) DC		360	530	350	590
Moisture Absorption (%)		0.05	0.4	0.3	0.01
Melting Point (°C)		285	265	230	160-170
Glass Transition Point (°C)		90	69	153	−15
Flammability		Self Exiting	Slow Burning	Fair	Slow Burning



SMD® Trimmer Capacitors Film Dielectric Series 2800S

Description

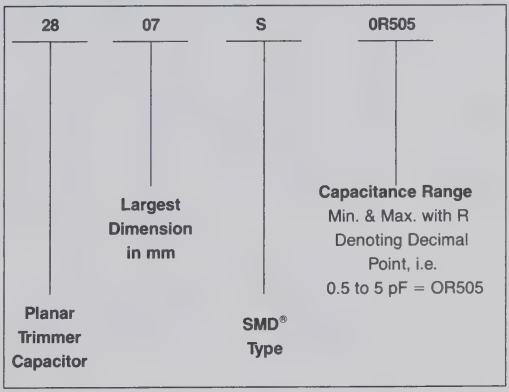
SMD® Trimmer Capacitors use a PTFE Teflon film dielectric for excellent long-term stability and low temperature coefficient of capacitance. These units consist of brass rotors and stators separated by film dielectric and enclosed in a plastic case. They are available taped and reeled for automatic assembly and can be reflow, vapor phase or hand soldered.

Features

- Product Available: Bulk or Blister Tape @ 3000 pcs/Reel
- True SMD Design for Surface Mounting
- Tight TC of −100 ± 100 PPM/°C for All Styles
- Wide Operating Temperature Range: −40°C to + 85°C

Part Number Designation

Series 2800S SMD® Film Dielectric Trimmer Capacitors can be completely specified using the following designation:



Electrical Specifications

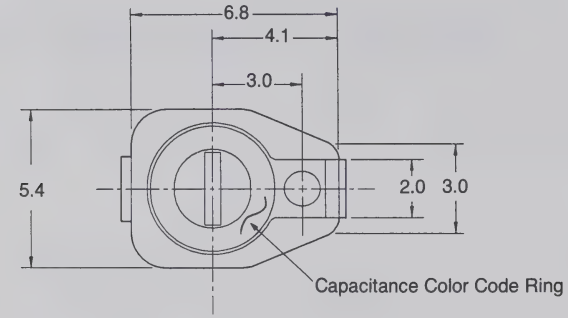
Philips Components Part Number	Capacitance Range (pF) Min.	Max.	L Inches	(mm)	Capacitance Color Code
2807S0R505	0.3±0.2	5—0.5/+3	.087	(2.2)	Orange
2807S0R610	0.4±0.2	10—1/+5	.087	(2.2)	Black
2807S0R815	0.5±0.3	15—0/+7	.094	(2.4)	Blue
2807S1R020	0.7±0.3	20—0/+10	.100	(2.55)	Green

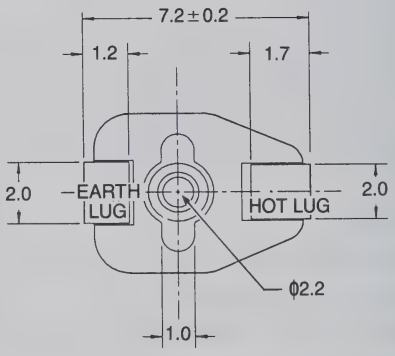
Insulation Resistance Between Stator and Rotor: 10,000 MΩ Minimum
Voltage Rating: 100V DC
Minimum Q @ 10MHz; 1000.
Temperature Coefficient PPM/°C −100±100.

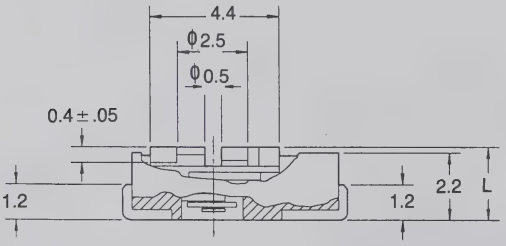
Soldering Maximum: 260°C for 5 seconds
Operating Temperature Range: −40 to 85°C
Effective Angle of Rotation: 360°
Operating Torque: 20 − 300 g. cm
Ratio of maximum torque to minimum shall be within 3:1

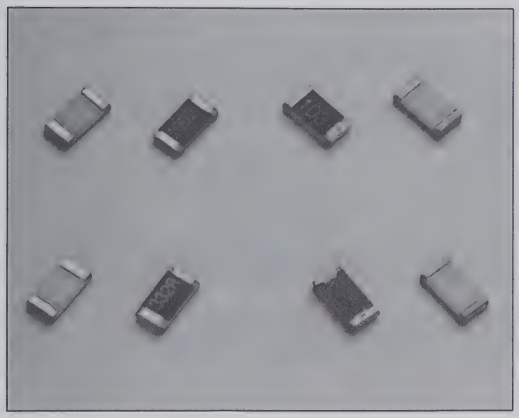
Mechanical Specifications

Dimensions: in Millimeters









Commercial SMD® Chip Resistors Series 9C

Description

The surface mounted chip resistor consists of a glass passivated thick film resistive paste screened onto a high purity alumina ceramic substrate. The nominal resistance value is achieved by varying the composition of the paste prior to the screening process and by laser trimming the film after it has been screened on. To insure mechanical and environmental integrity, the chip is covered with a protective coating. The conductive wrap around silver termination is barrier coated with nickel and then plated with tin/lead.

Features

- Superior volumetric efficiency
- Adaptable to high speed automated mechanization assembly
- Allows excellent printed circuit board density as well as utilization of both board sides
- Standard resistance values from 10Ω to 1MΩ for 1% product and 1Ω to 10MΩ for 5% product
- Zero Ω jumpers available
- Operating temperature range of −55°C to 125°C
- Power rating of 1/4, 1/8, 1/10 and 1/16 Watts
- 3 digit marking code on 5% product (Note: Carton code is 4 digit on 5% product)
- 4 digit marking code on 1% product

General Specifications

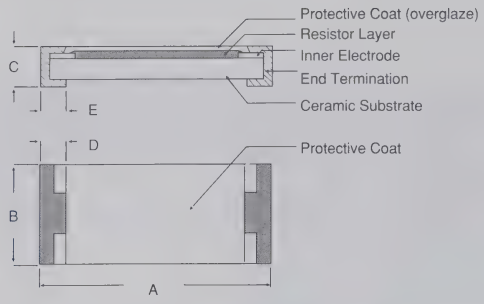
Chip Size	Wattage	Tolerance	T.C.	Max. Volts (RMS)	Value Range
1206	1/8, 1/4	± 5%	200	200	1R0–10M
1206	1/8	± 1%	100	200	10R0–1M
1206	1/8	± 1%	50	200	100R–1M
0805	1/10	± 5%	200	150	1R0–10M
0805	1/10	± 1%	100	150	10R0–1M
0603	1/16	± 5%	500	50	1R1–9R1
0603	1/16	± 5%	200	50	10R0–1M
0603	1/16	± 5%	300	50	1M1–6M8
0603*	1/16	± 1%	100	50	100R–1M

NOTE: 0603, 1%, to be available 4th Quarter 1992

Zero Ohm Jumper available in 1206 and 0805 sizes

9C1206 available in ±.5%, TC = 50 PPM—Consult factory

Mechanical Parameters



	A	B	C	D	E
1206 in.	.126±.006/−/.008	.063±.006	.024±.010	.018±.010	.020±.010
(mm)	(3.2±.15/−.20)	(1.6±.15)	(.60±.10)	(.45±.25)	(.50±.2)
0805 in.	.079±.006	.049±.004	.020±.004	.016±.008	.016±.008
(mm)	(2.0±.15)	(1.25±.10)	(.50±.10)	(.40±.20)	(.40±.20)
0603 in.	.063±.004	.031+.006/−.002	.018±.004	.012±.008	.012±.008
(mm)	(1.6±.10)	(.80+.15/−.05)	(.45±.10)	(.30±.20)	(.30±.20)

Performance Notes

Chips may be cemented in place for control during the soldering process by screened on solder paste or epoxy and may be mounted on printed circuit boards or ceramic substrates. The solder provides both an electrical contact as well as a mechanical retainer. Wrap around terminations allow for reflow and wave soldering.

Packaging

Chip resistors are supplied in tape and reel packaging. Quantities of 5000 pieces on cardboard carrier tape accommodates the use of automatic placement equipment. Consult the factory for other forms of packaging and availability.

Test Performance

Performance Characteristics
Per IEC 115-1

TEST	REQUIREMENTS (+.05 OHMS)	
	9C1206 1%, 100 PPM	5%, 200 PPM
Thermal Shock	+/−0.5%	+/−1.5%
S.T.O.L.	+/−0.5%	+/−2.0%
High Temperature	+/−0.5%	+/−1.0%
Steady State Moisture	+/−1.0%	+/−1.5%
Effects of Soldering	+/−0.5%	+/−1.0%
Vibration	+/−0.5%	+/−0.5%
Life	+/−0.5%	+/−1.0%
Solderability	95% Minimum Coverage	95% Minimum Coverage
	9C1206 1%, 50 PPM	
Thermal Shock	+/−0.25%	
S.T.O.L.	+/−0.25%	
High Temperature	+/−0.50%	
Steady State Moisture	+/−1.00%	
Effects of Soldering	+/−0.25%	
Vibration	+/−0.25%	
Life	+/−0.5%	
Solderability	95% Minimum Coverage	
	9C0805 1%, 100 PPM	**5%, 200 PPM**
Thermal Shock	+/−1.0%	+/−1.0%
S.T.O.L.	+/−1.0%	+/−1.0%
High Temperature	+/−1.5%	1R0-1M0 = +/−1.5% 1M1-10M = +/−3.0%
Steady State Moisture	+/−1.5%	1R0-1M0 = +/−1.5% 1M1-10M = +/−3.0%
Effects of Soldering	+/−1.0%	+/−1.0%
Vibration	+/−1.0%	+/−1.0%
Life	+/−2.0%	1R0-1M0 = +/−1.5% 1M1-10M = +/−3.0%
Solderability	95% Minimum Coverage	95% Minimum Coverage
	9C0603 1%, 100 PPM	**5%, 200,300,500 PPM**
Thermal Shock	N/A	+/−1.0%
S.T.O.L.	N/A	+/−1.0%
High Temperature	N/A	+/−3.0%
Steady State Moisture	N/A	1R0 − 9R1 = +/−5% 10R0 − 1M0 = +/−3% 1M1 − 10M = +/−5%
Effects of Soldering	N/A	+/−1.0%
Vibration	N/A	+/−1.0%
Life	N/A	1R0 − 9R1 = +/−5% 10R0 − 1M0 = +/−3% 1M1 − 10M = +/−5%
Solderability	N/A	95% Minimum Coverage

Part Number Designation

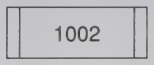
9C 1206 3 A 1002 F K

- Rectangular Chip Resistor
- **Chip Size**
  1206 0603
  0805
- **Power Rating**
  3 = 1/4 (1206, 5% only)
  3 = 1/8 (1206, 1% only)
  2 = 1/10
  1 = 1/16
- **Product Class**
  A = Standard
- **Resistance Value**
  4 Digits – ±1%, 5%
  Last Digit Represents Multiplier
- **Tolerance**
  F = ±1.0
  J = ±5.0
- **T.C. of R. (PPM/C)**
  C = ±50
  K = ±100
  L = ±200
  M = ±300
  X = Other (as specified in general specification)

Part Marking

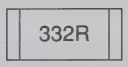
5% Tolerance—3 Digit Marking
1% Tolerance—4 Digit Marking

Examples:

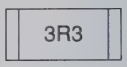


1% 1206 10 Kohm

5% 1206 10 Kohm



1% 1206 332 ohm



5% 1206 3.3 ohm

Chip Resistor Kits

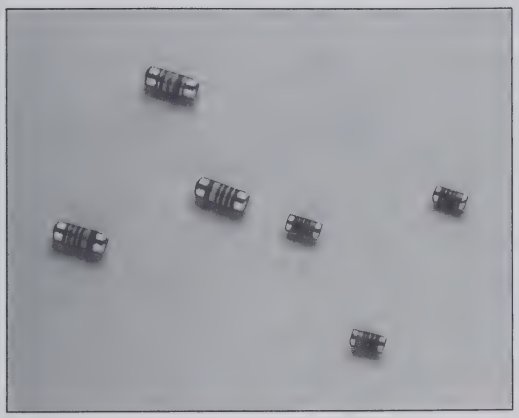
Series 9C SMD® Chip Resistors (1%)

	Qty. Each		Qty. Each		Qty. Each		Qty. Each
1. 9C12063A10R0FK	100	11. 9C12063A3400FK	100	21. 9C12063A2151FK	100	31. 9C12063A2002FK	200
2. 9C12063A47R5FK	100	12. 9C12063A3920FK	100	22. 9C12063A2491FK	100	32. 9C12063A1212FK	200
3. 9C12063A49R9FK	100	13. 9C12063A4750FK	100	23. 9C12063A3321FK	100	33. 9C12063A1502FK	200
4. 9C12063A75R0FK	100	14. 9C12063A4990FK	100	24. 9C12063A3921FK	100	34. 9C12063A2152FK	100
5. 9C12063A1000FK	200	15. 9C12063A6340FK	100	25. 9C12063A4641FK	100	35. 9C12063A3402FK	100
6. 9C12063A1500FK	100	16. 9C12063A6490FK	100	26. 9C12063A4751FK	200	36. 9C12063A4992FK	100
7. 9C12063A1690FK	100	17. 9C12063A9090FK	100	27. 9C12063A4991FK	200	37. 9C12063A1003FK	100
8. 9C12063A2000FK	100	18. 9C12063A1001FK	200	28. 9C12063A7501FK	100	38. 9C12063A2003FK	200
9. 9C12063A2490FK	100	19. 9C12063A1211FK	100	29. 9C12063A8251FK	100	39. 9C12063A4993FK	100
10. 9C12063A2670FK	100	20. 9C12063A2001FK	200	30. 9C12063A1002FK	200	40. 9C12063A1004FK	100

Series 9C SMD® Chip Resistors (5%)

	Qty. Each		Qty. Each		Qty. Each		Qty. Each
1. 9C12063A10R0JL	100	11. 9C12063A7500JL	100	21. 9C12063A1002JL	200	31. 9C12063A2203JL	100
2. 9C12063A27R0JL	100	12. 9C12063A9100JL	100	22. 9C12063A1502JL	100	32. 9C12063A4703JL	100
3. 9C12063A47R0JL	100	13. 9C12063A1001JL	200	23. 9C12063A2702JL	100	33. 9C12063A6803JL	100
4. 9C12063A51R0JL	100	14. 9C12063A1501JL	100	24. 9C12063A3302JL	100	34. 9C12063A1004JL	200
5. 9C12063A1000JL	200	15. 9C12063A2201JL	200	25. 9C12063A3902JL	100	35. 9C12063A1504JL	100
6. 9C12063A2200JL	100	16. 9C12063A2701JL	100	26. 9C12063A4702JL	200	36. 9C12063A2204JL	100
7. 9C12063A3300JL	100	17. 9C12063A3301JL	100	27. 9C12063A5102JL	100	37. 9C12063A3304JL	100
8. 9C12063A3900JL	100	18. 9C12063A4701JL	200	28. 9C12063A8202JL	200	38. 9C12063A5104JL	100
9. 9C12063A4700JL	100	19. 9C12063A5101JL	200	29. 9C12063A1003JL	100	39. 9C12063A1005JL	100
10. 9C12063A6800JL	100	20. 9C12063A7501JL	100	30. 9C12063A1503JL	100	40. 9C12063A0R00JL	200

Series 9C0805 kits also available



Precision MELF SMD® Resistors, Series 9B

Description

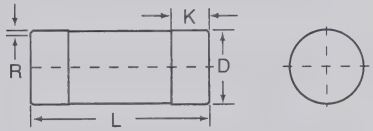
The MELF precision resistor benefits from the technology employed by Beyschlag of Germany in the manufacture of the leaded Space Miser metal film resistors. The MELF resistor consists of a high alumina core on which metal film is deposited. A cap is applied at each end and the resistor is spiralled to value. The resistor is then coated, color coded, and end caps treated to facilitate soldering.

Features

- Tolerance down to 0.1%
- Temperature coefficients down to ±5 PPM/°C
- 9B1406 1/4 W & 9B0805 1/8 W power ratings in miniature size
- Tape and reel packaging for automatic handling
- Specially treated end caps for excellent solderability
- Color coded for easy identification
- Thin film resistance element for low current noise
- Zero ohm, jumper, available

Mechanical Data

Outline Drawing Dimension in inches (mm)



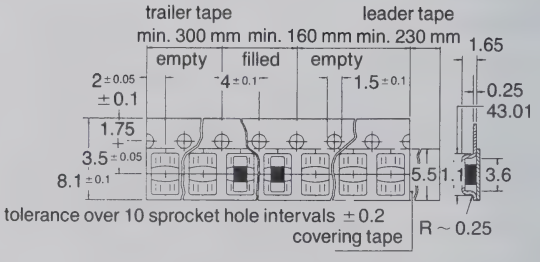
Body Style	L Min Max	D Max	K	R Max	Scale Defin.
Mini-MELF 9B1406	.136-.142 (3.47-3.60)	0.055 (1.4)	.023-.034 (0.6-0.85)	0.006 (0.15)	in mm
Micro-MELF 9B0805	0.087 (2.2)	0.039 (1.1)	0.014-0.018 (0.35-0.45)	0.002 (0.05)	in mm

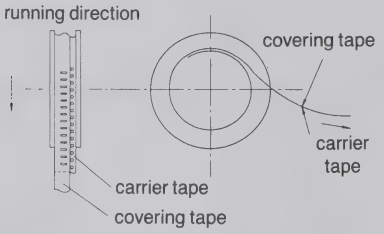
Performance Specifications

Test	Procedure	Requirements
Thermal Shock	−65 to +155°C, 30 minutes at each temperature, 5 cycles	△R max. ±(0.25%+0.05Ω)
Short Time Overload	2.5X RCWV, not to exceed 400 V. 5 seconds	△R max. ±(0.25%+0.05Ω)
Moisture	Per Mil. Std. 202 Method 106 to conditions of Mil-R-55342	△R max. ±(0.25%+0.05Ω)
Damp Heat	56 days at 40°C, 93% R.H. with 0.1 RCWV, not to exceed 16 V, applied	△R max. (+1.0%/ − 0.5%+0.05Ω)
Solderability	5 seconds at 230°C	95% coverage minimum
Effect of Soldering	3 seconds at 350°C	△R max. ±(0.25%+0.05Ω)
Life Test 9B1406	1000 hours, rated power at 70°C. Voltage not to exceed 200V. Power applied 90 minutes on, 30 minutes off	R ≤ 330K, △R max. ±(0.25% + 0.05Ω) R > 330K, △R max. ±(0.5% + 0.05Ω)
Life Test 9B0805	1000 hours, rated power at 70°C. Voltage not to exceed 100V. Power applied 90 minutes on, 30 minutes off	△R max. ±(0.25%+0.05Ω)

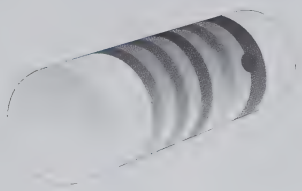
Auto-Placement Machines and Component Adhesives

A variety of auto-placement machines are available which are capable of placing bulk and/or taped and reeled parts. Associated with these machines are component adhesive application equipment, which may or may not be integrated into the auto-placement machines. Generally, manufacturers of integrated systems define the type of adhesive required. User specification will define the type of equipment best suited to a particular application.





Part Marking



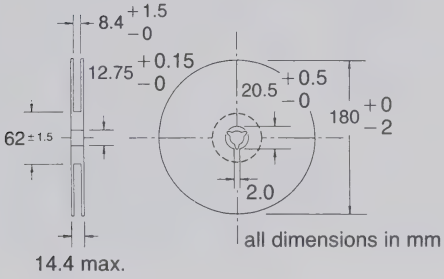
Temperature coefficient is indicated by color dot.

No Dot: ±50 PPM/°C
Orange: ±15 PPM/°C
Blue: = ±10 PPM/°C
Yellow: ±25 PPM/°C
Black: = UHF
Violet: = ±5 PPM/°C

Color	Figure	Multiplier	Tolerance
Black	0	1	—
Brown	1	10	1%
Red	2	100	2%
Orange	3	1K	—
Yellow	4	10K	—
Green	5	100K	.5%
Blue	6	1M	.25%
Violet	7	—	.1%
Gray	8	—	—
White	9	—	—
Gold	—	.1	5%
Silver	—	.01	—

Packaging

Series 9B Precision MELF resistors are available in bulk, packed in plastic containers, 1000 pieces per container and taped and reeled, per EIA RS-481, in 8 mm blister tape. Quantity per reel is 3000 pieces. 10,000 piece reels available on request.



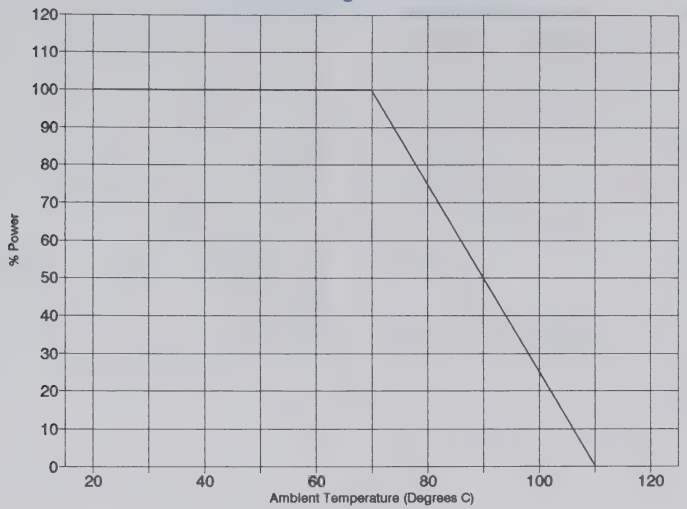
Electrical Specifications

TC $10^{-6}/°K$	Style	5% (J)	2% (G)	1% (F)	0.5% (D)	0.25% (C)	0.1% (B)
±50	Mini-MELF 1406	OR22-10M	1R-10M	1R-10M	10R-475k	22R-332k	43R-332k
	Micro-MELF 0805		1R-9R1	10R-1M	47R-100k	100R-100k	Consult Factory
±25	Mini-MELF 1406			10R-475k	10R-475k	22R-332k	43R-332k
	Micro-MELF 0805			10R-221k	47R-100k	100R-100k	Consult Factory
±15	Mini-MELF 1406				10R-221k	22R-221k	43R-221k
	Micro-MELF 0805				100R-100k	100R-100k	Consult Factory
±10	Mini-MELF 1406					43R-221k	43R-221k
	Micro-MELF 0805					Consult Factory	Consult Factory
±5	Mini-MELF 1406					100R-100k	100R-100k
	Micro-MELF 0805					Consult Factory	Consult Factory

Zero Ohm Jumper available in Mini-MELF and Micro-MELF.

Application Information

Power Derating 9B1406 & 9B0805



Frequency Response

A special "HF" version of the 9B1406 Mini-MELF has been developed having improved RF characteristics. The inductive reactances have been minimized on values ranging from 1.5 Ohms to 470 Ohms (1%, 2%, 5% tolerance). 9B0805 Micro-MELF has also been developed with improved RF characteristics. The 9B0805 Micro-MELF is available in values ranging from 4.7 Ohms to 470 Ohms (2%, 5% tolerance). Figures 1 and 2 compare the standard Mini-MELF and HF Mini-MELF resistors. (Notice that the impedance has been normalized to the dc resistance.)

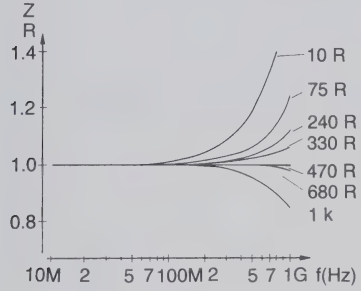


Figure 1: Frequency Response of standard MELFs

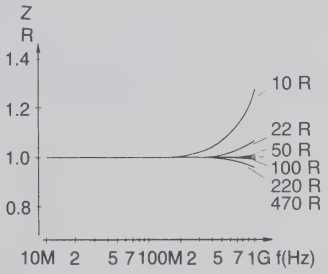


Figure 2: Frequency Response of HF MELFs

Current Noise

When a dc current passes through a resistor, voltage fluctuation occurs. This results in noise which can be measured by an rms voltmeter. Current noise is generally presented as a μVrms/Vdc ratio (rms voltage produced by a given dc voltage). Since the band-pass of the measuring circuit is one decade centered on 1KHz, this ratio is known as "microvolts per volt in a decade" noise index. The power of the noise index can be calculated by using the following equation:

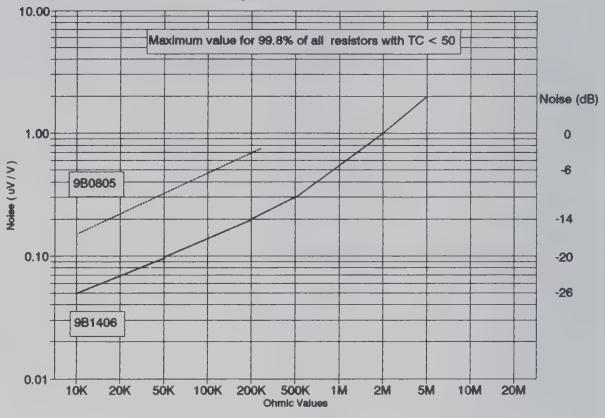
$$\text{Noise Index (dB)} = 20 \text{ Log}_{10} (\mu\text{Vrms/Vdc})$$

The current noise for 9B MELF resistors is presented in Figure 3.

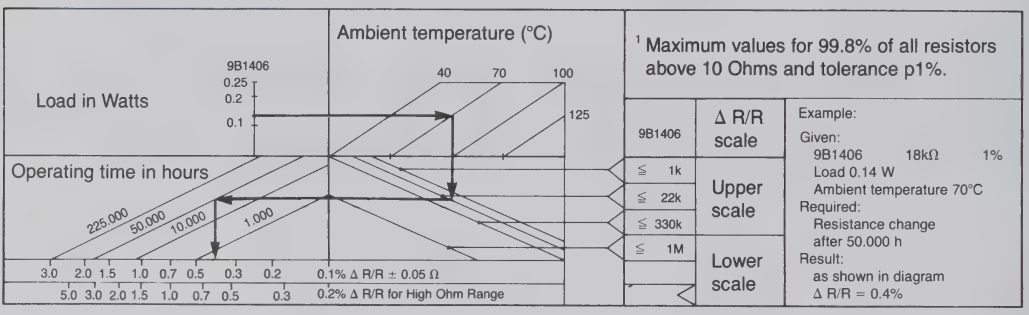
Current noise is dependent on the type of resistive material, film thickness, the shape and size of the resistive path, and the quality of spiralling (used to establish desired resistance value).

Current noise is an important cause of interference at low level audio frequencies or in low frequency circuits.

Figure 3 Current Noise



Time-Stability Nomogram



Bend Test

Printed circuit boards are frequently subjected to flexural forces during chassis mounting, thermal mismatch, and/or vibration. Numerous occurrences of terminal fracture/separation in ceramic chip components have been reported by the electronics industry, which has prompted surface mounted component bend testing.

Series 9B MELF resistors are soldered to a 1.5 mm thick printed circuit board which is placed upon two supports, each 45 mm from the center of the body (see Figure 4). A force sufficient to deflect the board 1 mm is applied to a 20 mm wide block, which is centered on the back of the board. While in this state of flexure, the dc resistance of the MELF is measured. Any resistance change must not exceed +/−(0.25% +0.05 Ohms). Series 9B MELF resistors can be subjected to 5 flexures of 5 mm deflection without resistor interruption.

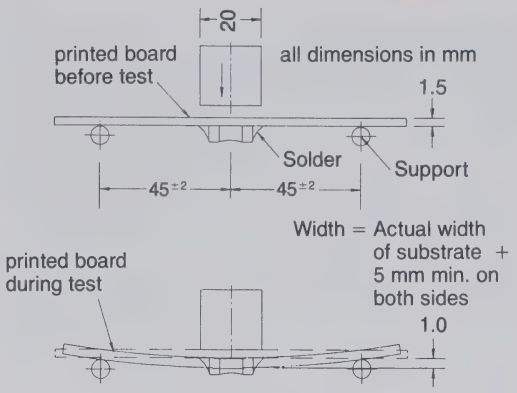


Figure 4: Bend test fixture used to test the effects of pc board flexure.

Pulse Load—Single Pulse

The 9B Mini-MELF resistors are capable of withstanding single voltage pulses in excess of the maximum continuous working voltage without resistance degradation. This is dependent on the pulse duration and the peak pulse voltage.

Figure 5 shows the results of discharging a 16uF capacitor through a 1 kOhm Mini-MELF. The capacitor was initially charged to noncritical voltage levels and, as the test progressed, incremented to the point of resistor destruction. New resistors were used at each increment. As shown, significant resistance change began to occur at 390 Vdc. Notice that the resistance value approached infinity asymptotically at approximately 508 Vdc, the point where the resistive layer underwent destruction.

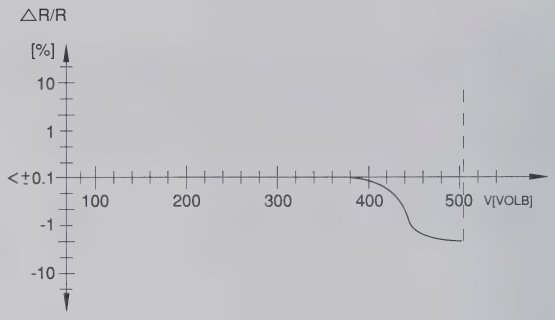


Figure 5: Effects of pulse voltages on a 1 kOhm Mini-MELF resistor.

Pulse Load Characteristics

Examples for pulse groups

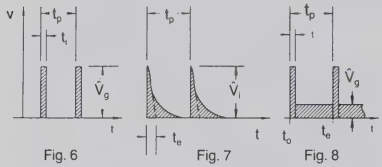
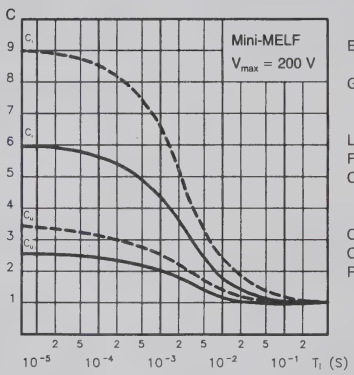


Fig. 6 Fig. 7 Fig. 8

----- Operating time 10 000 hours
—— Operating time 225 000 hours



Example:	Pulse load rating for continuous operation
Given:	Mini-MELF, R = 1 kΩ; ϑ_a = 70°C $\hat{V}_i$ = 50 V; t_i = 2 ms; t_p = 0.1 S (rectangular pulse see fig. 1)
Limits:	P_{70} = 0.25 W; Vmax = 200 V
From diagram:	c_1 = 3.5; c_u = 1.8
Condition (1):	For special case rectangular pulse $\frac{\hat{V}_i^2}{R} \cdot \frac{t_i}{t_p} = 0.005\ W \leqq 0.25\ W = P_{70}$
Condition (2):	$I\hat{V}_i I = 50\ V \leq c_1 \cdot \sqrt{P_{70} \cdot R} = 55\ V$
Condition (3):	$I\hat{V}_i I = 50\ V \leqq c_u \cdot Vmax = 360\ V$
Result:	All three conditions are fulfilled, the load is permissible.

Philips Components Mini-MELF metal film resistors with high dissipation ceramic CORES have a specially good pulse loadability. For a short time the resistors can be loaded up to 81 times their rated dissipation without impairing their good long term characteristics. The permissible pulse load must fulfill 3 conditions simultaneously:

1. The average value of the pulse load must not be greater than the permissible dissipation of the resistor at the given ambient temperature ϑ

$$P\vartheta \leq \frac{1}{t_p \cdot R} \int_{ta}^{te} \hat{V}_i^2 \, dt$$

The solution of the integral shows for the following special cases:

Rectangular pulse $P\vartheta \leq \frac{\hat{V}_i^2 \cdot t_i}{R \cdot t_p} + \frac{Vg}{R}\left(1 - \frac{ti}{tp}\right)$ Fig. 8

Exponential pulse $P\vartheta \leq \frac{\hat{V}_i^2 \cdot \tau_e}{R \cdot 2 \cdot t_p}$ Fig. 7

2. The pulse voltage at the resistor must be smaller than the product rated voltage · c_i

$$\hat{V}_i \leq c_i \cdot \sqrt{P\,\vartheta \cdot R}$$

3. The pulse voltage at the resistor must be smaller than the product Vmax · c_u

$$V_i \leqq c_u \cdot Vmax$$

The course of $\hat{V}_i$ must be measured directly on the resistor!

P = Permissible dissipation in Watts at the ambient temperature ϑ
t_p = Period time
R = Resistance value
V_i = Peak voltage of the pulse
t_i = Pulse time
V_g = d.c. voltage between the pulses
t_a = Time at the beginning of the pulse period
t_e = Time at the end of the pulse period
Vmax = Limiting element voltage for continuous operation of the resistor
c_i = Factor interdependent on time for exceeding the rated dissipation
c_u = Factor interdependent on time for the permissible exceeding of Vmax
τ_e = Time constant of the exponential pulse

The conditions ② and ③ must also be fulfilled for "needle pulses" with pulse times $< 1\mu$ sec. Lack of attention to the needle pulses can cause a defect in the resistor. The data for pulse loadability are only conditionally applicable for pulse rise times less than 10^{-8}.

NOTE: Pulse handling data for Micro-MELF is not available at this time.

Part Number Designation

Philips Components' MELF Resistors can be completely specified using the following designation:

9B	1406 0805	4	A	1002	C	F	B
Melf Resistor	Melf Size .142 × 0.55 inch 3.6 × 1.4 mm .087 × .039 inch 2.2 × 1.1 mm	Power Rating (70°C) .25 Watt = 4 .125 Watt = 3	Product Class A = Standard Z = Custom	Resistance Value 100 = Significant Digits 2 = Multiplier (for values less than 100Ω use "R" as decimal designator.) i.e.: 68RO = 68Ω 1002 = 10KΩ	Resistance Tolerance B = ±.10% F = ±1.0% C = ±.25% G = ±2.0% D = ±.5% J = ±5.0%	Temperature Coefficient PPM/°C F = ±15 C = ±50 E = ±25 B = ±10 A = ±5	Packaging A – antistatic plastic T and R B = Bulk T = Flexacon metal T and R

NOTE: Part Number must correlate with the power ratings for the 9B1406 and 9B0805 MELFs and must correlate to the tolerances, temperature characteristics, and ohmic value ranges specified in the "Electrical Specifications" Table.

Surface Mount Thermistors Series 633 NTC

Description

Directly heated negative temperature coefficient thermistors primarily intended for temperature sensing and control

Features

- The non-dimensioned details do not affect the performance of the device.
- The SOD-80 envelope is suitable for surface mounting.
- Terminations are tinned copper-clad iron.

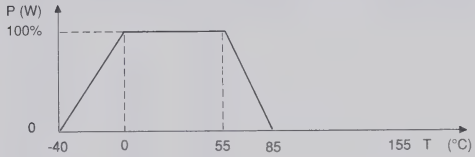
Table 1

R_{25}	$B_{25/85}$		Code number 2322 633 5
ohm	K	±%	R_{25} ± 5%
10000	3977	1.3	3103
20000	3977	1.3	3203
30000	3977	1.3	3303

1. Ratings and Characteristics

Standard selection tolerance on R_{25}	: ±5
Climatic category	: 40/155/56
Resistance at 25°C	: see table 1
$B_{25/85}$ values	: see table 1
Tolerance on B value	: see table 1
Rated dissipation	: 100mW
Ratio R_T/R_{25}	: see table 2
Deviation in resistance value due to B tolerance	: see table 2
Temperature coefficient	: see table 2
Rated temperature range	−40 to ±55°C

2. Derating curve:



3. Marking: none
4. Weight: 0,03 g approx.
5. Packing: to be specified
6. Curves: Resistance–Temperature : see Figure 1

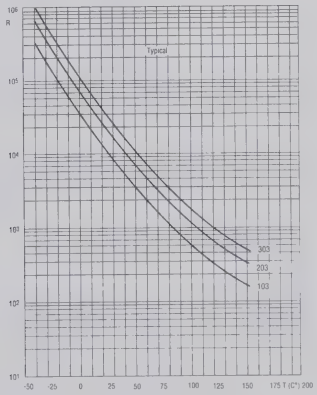
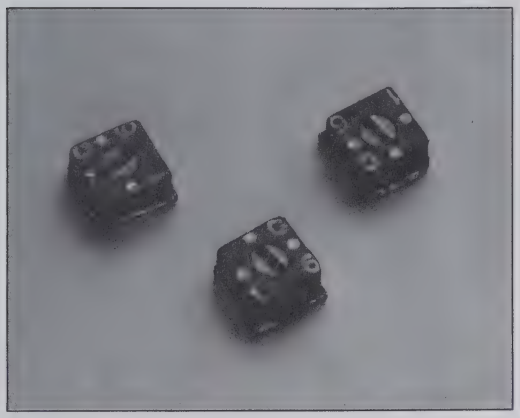


Table 2

Temperature	Ratio R_T/R_{25}	Deviation in R due to B tolerance	Temp. coeff.	Resistance value (k ohm) for 2322 633		
°C		%	%/K	5.3103	5.3203	5.3303
−40	33.06	4.65	6.59	330.6	661.2	991.8
−35	23.90	4.21	6.37	239.0	478.1	717.1
−30	17.47	3.79	6.16	174.7	349.4	524.1
−25	12.90	3.38	5.96	129.0	258.0	387.0
−20	9.621	2.99	5.77	96.21	192.4	288.6
−15	7.242	2.61	5.59	72.42	144.8	217.3
−10	5.501	2.24	5.41	55.01	110.0	165.0
−5	4.214	1.89	5.24	42.14	84.28	126.4
0	3.255	1.55	5.08	32.55	65.09	97.64
5	2.534	1.22	4.93	25.34	50.67	76.01
10	1.987	0.90	4.78	19.87	39.74	59.62
15	1.570	0.59	4.64	15.70	31.40	47.10
20	1.249	0.29	4.51	12.49	24.98	37.46
25	1.000	0.00	4.38	10.00	20.00	30.00
30	0.8059	0.28	4.25	8.059	16.12	24.18
35	0.6534	0.55	4.13	6.534	13.07	19.60
40	0.5329	0.82	4.02	5.329	10.66	15.99
45	0.4371	1.08	3.91	4.371	8.742	13.11
50	0.3604	1.34	3.80	3.604	7.209	10.81
55	0.2988	1.58	3.70	2.988	5.976	8.963
60	0.2489	1.82	3.60	2.489	4.978	7.467
65	0.2084	2.06	3.51	2.084	4.168	6.251
70	0.1753	2.29	3.42	1.753	3.505	5.258
75	0.1481	2.51	3.33	1.481	2.961	4.442
80	0.1256	2.73	3.24	1.256	2.512	3.769
85	0.1070	2.95	3.16	1.070	2.141	3.211
90	0.09156	3.16	3.08	0.9156	1.831	2.747
95	0.07862	3.36	3.01	0.7862	1.572	2.359
100	0.06777	3.56	2.93	0.6777	1.355	2.033
105	0.05863	3.76	2.86	0.5863	1.173	1.759
110	0.05089	3.95	2.79	0.5089	1.018	1.527
115	0.04433	4.13	2.73	0.4433	0.8865	1.330
120	0.03873	4.32	2.66	0.3873	0.7747	1.162
125	0.03395	4.50	2.60	0.3395	0.6791	1.019
130	0.02985	4.67	2.54	0.2985	0.5971	0.8956
135	0.02633	4.84	2.49	0.2633	0.5265	0.7898
140	0.02328	5.01	2.43	0.2328	0.4656	0.6984
145	0.02065	5.17	2.38	0.2065	0.4129	0.6194
150	0.01836	5.33	2.32	0.1836	0.3671	0.5507
155	0.01636	5.49	2.27	0.1636	0.3273	0.4909



Surface Mount Trimming Potentiometer, 3 mm Square Single Turn, Cermet Model ST-3

Features

- Sealed to Allow for Automatic Processing
- Precious Metal Alloy Contact
- Chip Style Design for Compact Size
- Tape and Reel and Bulk Packaging

Specifications

Electrical

Resistance Range	: 10 Ohms to 1 Meg. Ohms
Resistance Tolerance	: ±20% Standard
Temp. Coeff. of Resistance	: 10 Ohms to 50 Ohms ±250 ppm/°C 100 Ohms to 1 Meg. Ohm ±100 ppm/°C
Power Rating	: 0.125 Watt at 70°C
Operating Voltage Max.	: 200 VDC or power rating, whichever is less.
Wiper Current Max.	: 100 mA or power rating, whichever is less.
Electrical Angle, Nominal	: 210° nominal.
Electrical Continuity	: Continuous over full mechanical range.
End Resistance	: 1% or 2 Ohms, whichever is greater.
Resolution	: Essentially infinite.
Contact Resistance Variation	: 1% or 3 Ohms, whichever is greater.
Operating Temp. Range	: −55°C to + 125°C.
Insulation Resistance, Min.	: Min. 1000 Meg. at 500 VDC.
Dielectric Strength	: 500 VAC rms, 1 minute, 1 milliamp max.

Mechanical

Mechanical Angle, Nominal	: 240° Nominal
Operating Torque	: 50 gram-cm max. (.69 oz.-in.)
Stop Strength, Min.	: 200 gram-cm min. (2.8 oz.-in.)
Terminal Strength, Min.	: Not Applicable
Rotational Life	: 100 cycles (▲R/R ≤ 2 Ohms + 3%)

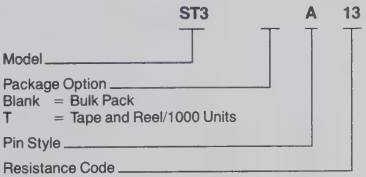
Environmental (MIL-R-22097)

Thermal Shock: (−65°C to 125°C)	▲R/R ≤ 2.00 ▲SS ≤ 1.00%
Humidity: (80 ~ 98% Rh, 240 hrs.)	▲R/R ≤ 2.00%
Mech. Shock: (100 g)	▲R/R ≤ 1.00% ▲SS ≤ 1.00%
Vibration: (20 g, 10 to 2000 Hz.)	▲R/R ≤ 1.00% ▲SS ≤ 1.00%
Low Temp. Operation: (−55°C, 2 hrs.)	▲R/R ≤ 2.00% ▲SS ≤ 2.00%
High Temp. Exposure: (125°C, 250 hrs.)	▲R/R ≤ 3.00% ▲SS ≤ 2.00%
Load Life: (70°C, 0.125 W, 1000 hrs.)	▲R/R ≤ 3.00% ▲SS ≤ 1.00%
Soldering Heat: (215°C, 35 sec. or 260°C, 10 sec.)	▲R/R ≤ 1.00%
Immersion: Fluorocarbon Liquid, 85°C, 1 min.	No Leaks

Standard Resistance Values and Codes

Ω	Code	Mark	Ω	Code	Mark
10	100	11	10 K	103	14
20	200	21	20 K	203	24
50	500	51	50 K	503	54
100	101	12	100 K	104	15
200	201	22	200 K	204	25
500	501	52	500 K	504	55
1 K	102	13	1 M	105	16
2 K	202	23			
5 K	502	53			

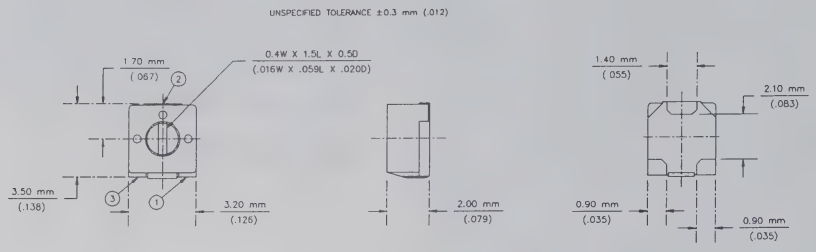
Part Number



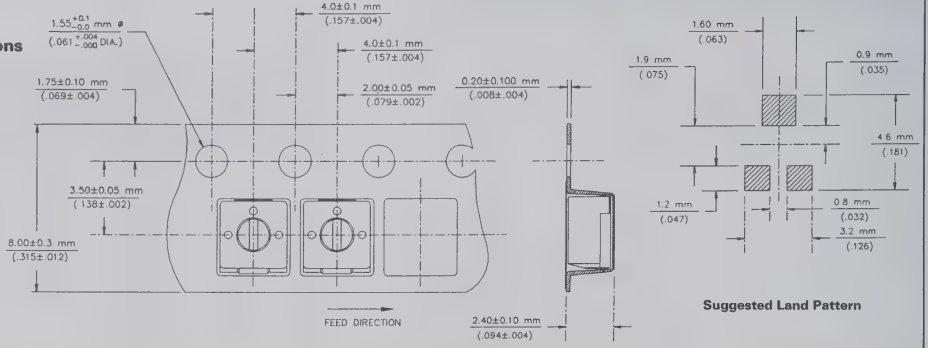
Marking

Units marked with resistance code and 1 digit date code

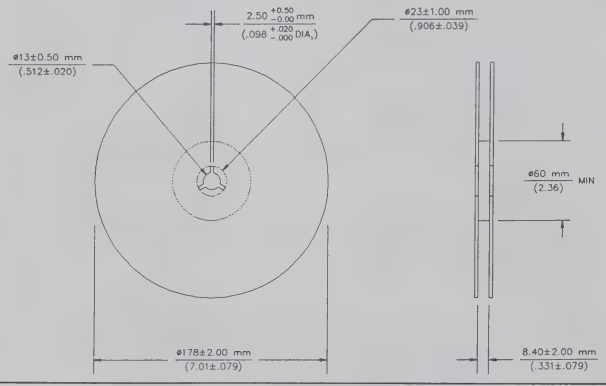
ST-3A
Top Adjust

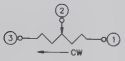


ST-3
Tape Dimensions



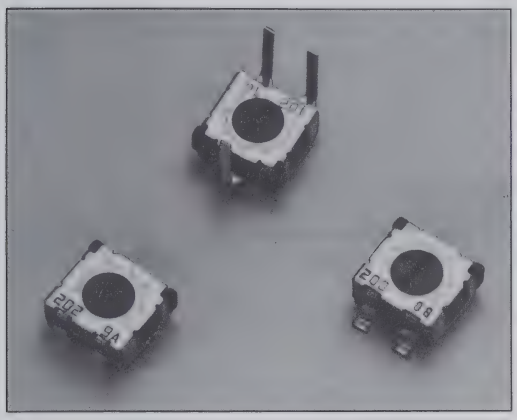
ST-3
Reel Dimensions





Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).



Surface Mount Trimming Potentiometer, 4 mm Square Single Turn, Cermet Model ST-4

Features

- Sealed to Allow for Automatic Processing
- Vertical and Horizontal Adjustment Styles
- Gull Wing, J Lead and Thru Hole Pin Styles
- Precious Metal Alloy Contact
- Tape and Reel, Magazine and Bulk Packaging

Specifications

Electrical

Resistance Range	: 10 Ohms to 2 Meg. Ohms
Resistance Tolerance	: ±20% Standard
Temp. Coeff. of Resistance	: 100 Ohms to 2 Meg. ±100 ppm, Others ±250 ppm.
Power Rating	: 1/4 Watt at 70°C
Operating Voltage Max.	: 200 VDC or power rating, whichever is less.
Wiper Current Max.	: 100 mA or power rating, whichever is less.
Electrical Angle, Nominal	: 210° Nominal.
Electrical Continuity	: Continuous over full mechanical range.
End Resistance	: 1% or 2 Ohms, whichever is greater.
Resolution	: Essentially infinite.
Contact Resistance Variation	: 1% or 3 Ohms, whichever is greater.
Operating Temp. Range	: −55°C to 125°C.
Insulation Resistance, Min.	: Min. 1000 Meg. at 500 VDC for 2 min.
Dielectric Strength	: 500 VAC rms, 1 minute, 1 milliamp max.

Mechanical

Mechanical Angle, Nominal	: 240° Nominal
Operating Torque	: 100 gram-cm max. (1.39 oz-in.)
Stop Strength, Min.	: 300 gram-cm min. (4.17 oz-in.)
Rotational Life	: 100 cycles, (▲ R/R ≤ 2 Ω + 3%)

Environmental (MIL-R-22097)

Thermal Shock: (−65°C to 125°C)	▲ R/R ≤ 2.00 ▲ SS ≤ 1.00%
Humidity: (80 ~ 98% Rh, 240 hrs.)	▲ R/R ≤ 2.00%
Mech. Shock: (100 g, 6 axes, 3 times)	▲ R/R ≤ 1.00% ▲ SS ≤ 1.00%
Vibration: (20 g, 10 to 2000 Hz.)	▲ R/R ≤ 1.00% ▲ SS ≤ 1.00%
Low Temp. Operation: (−55°C, 2 hrs.)	▲ R/R ≤ 2.00% ▲ SS ≤ 2.00%
High Temp. Exposure: (125°C, 250 hrs.)	▲ R/R ≤ 3.00% ▲ SS ≤ 2.00%
Load Life: (70°C, 0.25 W, 1000 hrs.)	▲ R/R ≤ 3.00% ▲ SS ≤ 1.00%
Soldering Heat: (260°C, 10 sec. or 215°C, 3 min.)	▲ R/R ≤ 1.00%
Immersion: Fluorocarbon Liquid, 85°C, 1 min.	No Leaks ≤

Standard Resistance Values and Codes			
Ω	Code	Ω	Code
10	100	10 K	103
20	200	20 K	203
50	500	50 K	503
100	101	100 K	104
200	201	200 K	204
500	501	500 K	504
1 K	102	1 M	105
2 K	202	2 M	205
5 K	502		

Part Number

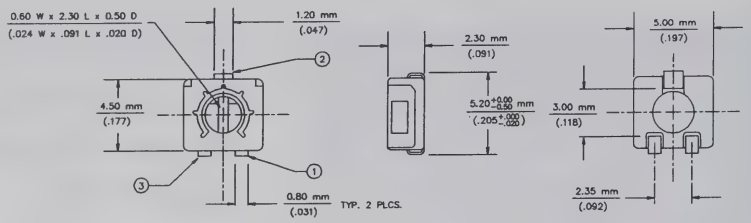
ST4 A 103

- Model
- Package Option
  - Blank = Bulk Pack
  - T = Tape and Reel/500 Units
  - M = Magazine/50 Units
- Pin Style
- Resistance Code

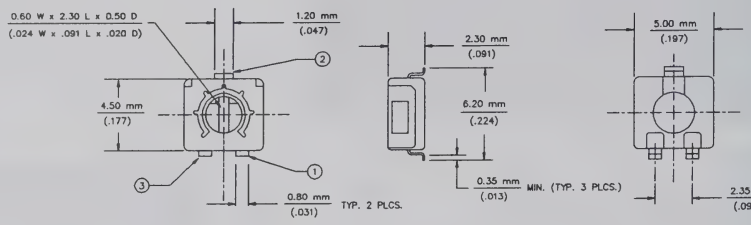
Marking

Units marked with resistance code, and 2 digit date code

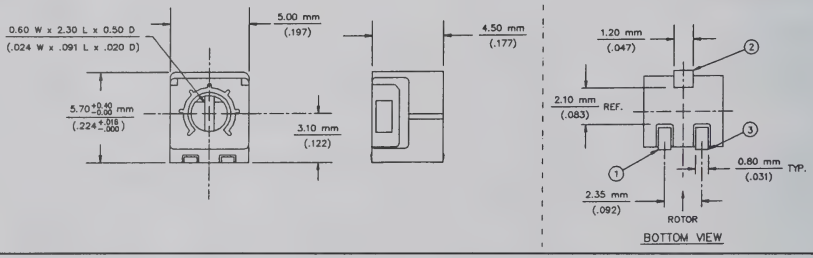
ST-4A
J Lead
Top Adjust



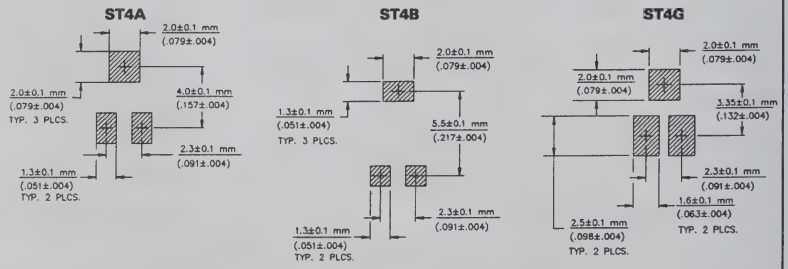
ST-4B
Gull Wing
Top Adjust

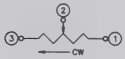


ST-4G
J Lead
Side Adjust



SUGGESTED LAND PATTERNS
A and B Styles Conform to Industry Standard, VRCI SMT–300, for 4 mm Single Turn Center Line of Part Falls on Center Line of Pattern



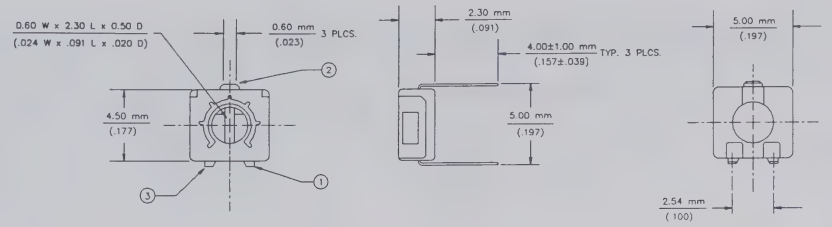


Metric

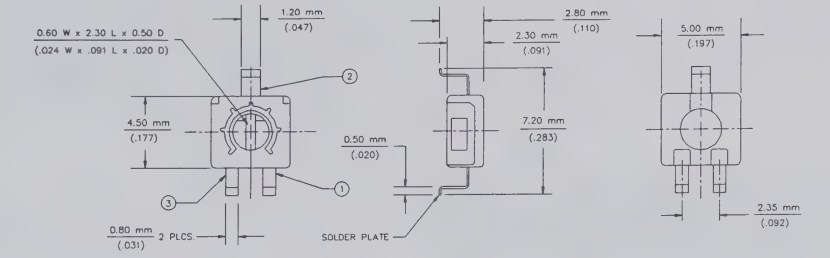
1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).
3. See packaging options on following pages for packaging dimensions.

Mepcopal Company, 1525 Sorrento Valley Road, San Diego, CA 92121-1307 (619) 481-0210

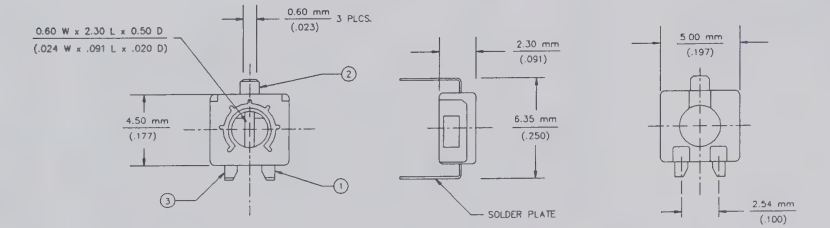
ST-4C
Thru Hole
Top Adjust



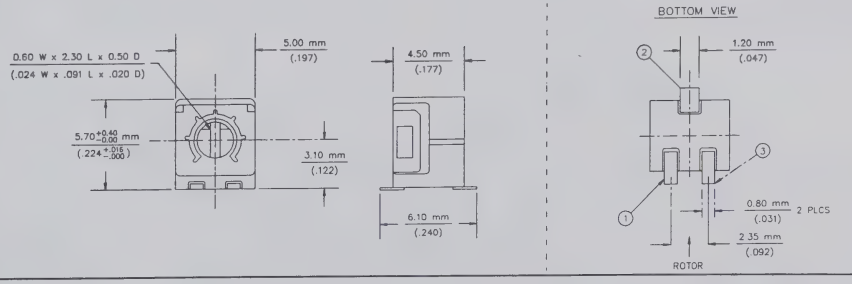
ST-4D
Gull Wing
Bottom Adjust
Semi Standard



ST-4F
Thru Hole
Bottom Adjust
Semi Standard

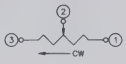


ST-4H
Gull Wing
Side Adjust
Semi Standard

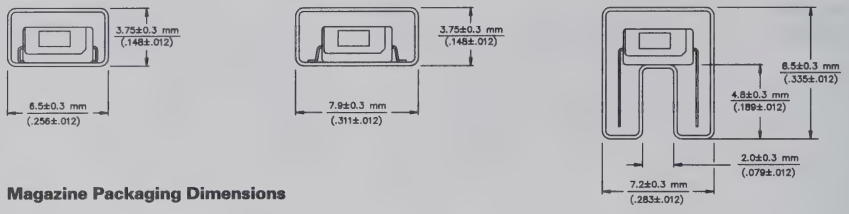


Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).
3. See packaging options on following pages for packaging dimensions.

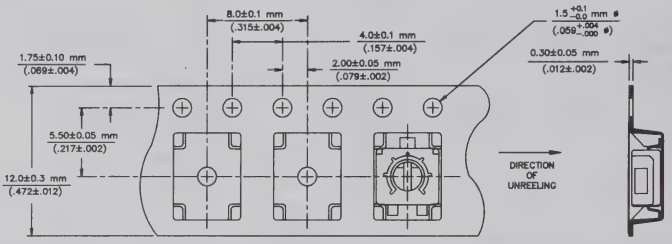


ST-4M

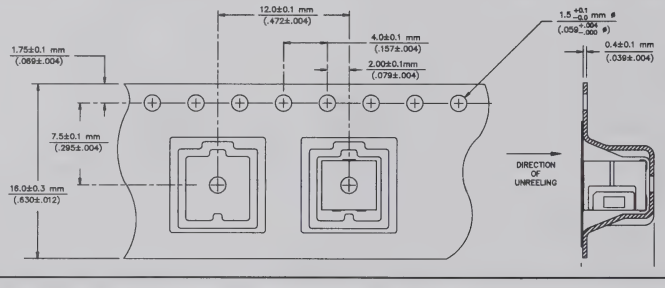


Magazine Packaging Dimensions

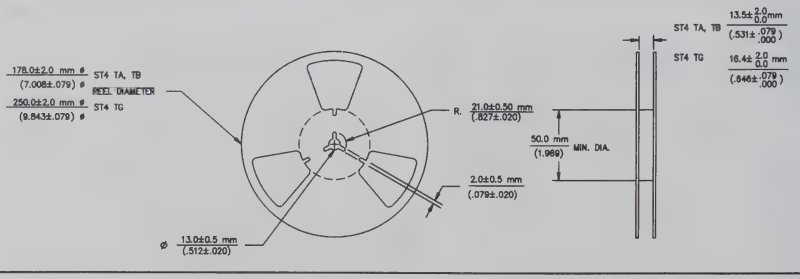
ST4TA
ST4TB
Tape Dimensions



ST4TG
Tape Dimensions

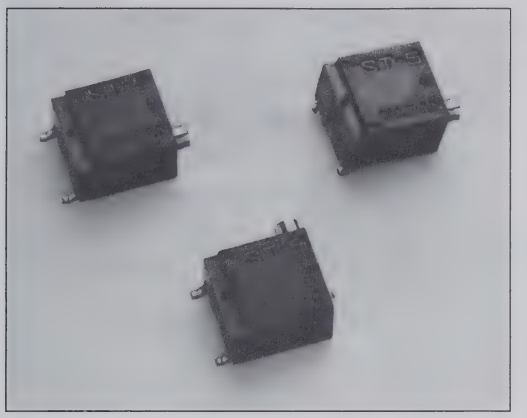


Reel Dimensions



Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).



Surface Mount Trimming Potentiometer, 6 mm Square Multiturn, Cermet Model ST-5

Features

- Sealed to Allow for Automatic Processing
- Vertical and Horizontal Mount/Adjust Styles
- Precious Metal Alloy Contact
- Tape and Reel, Magazine and Bulk Packaging

Specifications

Electrical

Resistance Range	: 10 Ohms to 2 Meg. Ohms
Resistance Tolerance	: ±10% Standard
Temp. Coeff. of Resistance	: 100 Ohms to 2 Meg., ±100 ppm/°C Others ±250 ppm/°C.
Power Rating	: 1/4 Watt at 85°C
Operating Voltage Max.	: 200 VDC or power rating, whichever is less.
Wiper Current Max.	: 100 mA or power rating, whichever is less.
Electrical Angle, Nominal	: 11 Turns Nominal.
Electrical Continuity	: Continuous over full mechanical range.
End Resistance	: 1% or 2 Ohms, whichever is greater.
Resolution	: Essentially infinite.
Contact Resistance Variation	: 1% or 3 Ohms, whichever is greater.
Operating Temp. Range	: −55°C to +125°C.
Insulation Resistance, Min.	: Min. 1000 Meg. at 500 VDC for 2 minutes.
Dielectric Strength	: 600 VAC rms, 1 minute, 1 milliamp max.

Mechanical

Mechanical Angle, Nominal	: 14 Turns Nominal
Operating Torque	: 200 Gram-cm (2.78 oz.-in.) max.
Stop Strength, Min.	: Not Applicable, Wiper Idles
Rotational Life	: 200 cycles, 10 Ω to 200 Ω (▲ R/R ≤ 0.5Ω + 3%) 500 Ω to 2 MΩ (▲ R/R ≤ 0.5Ω + 2%)

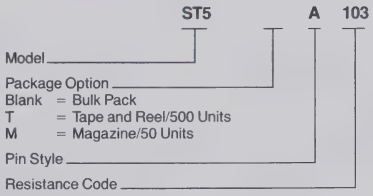
Environmental (MIL-R-22097)

Thermal Shock: (−65°C to 125°C)	▲ R/R ≤ 1.00% ▲ SS ≤ 1.00%
Humidity: (80 ~ 98% Rh, 240 hrs.)	▲ R/R ≤ 1.00%
Mech. Shock: (100 g)	▲ R/R ≤ 1.00% ▲ SS ≤ 1.00%
Vibration: (20 g, 10 to 2000 Hz.)	▲ R/R ≤ 1.00% ▲ SS ≤ 1.00%
Low Temp. Operation: (−55°C, 2 hrs.)	▲ R/R ≤ 2.00% ▲ SS ≤ 2.00%
High Temp. Exposure: (125°C, 250 hrs.)	▲ R/R ≤ 2.00% ▲ SS ≤ 2.00%
Load Life: (85°C, 0.25 W, 1000 hrs.)	▲ R/R ≤ 2.00% ▲ SS ≤ 1.00%
Soldering Heat: (215°C, 3 min. or 260°C, 10 sec.)	▲ R/R ≤ 1.00%
Immersion: Fluorocarbon Liquid, 85°C, 1 min.	No Leaks

Standard Resistance Values and Codes

Ω	Code	Ω	Code
10	100	10 K	103
20	200	20 K	203
50	500	50 K	503
100	101	100 K	104
200	201	200 K	204
500	501	500 K	504
1 K	102	1 M	105
2 K	202	2 M	205
5 K	502		

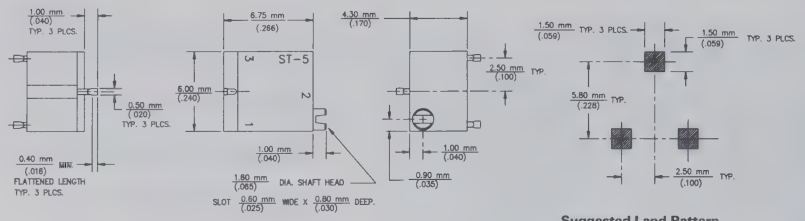
Part Number



Marking

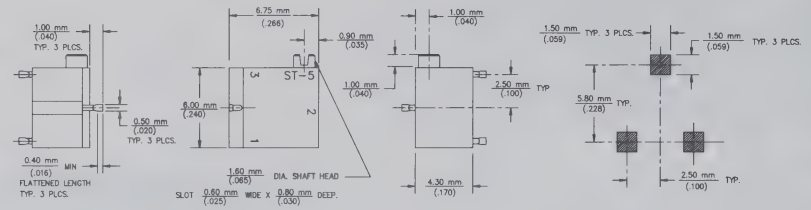
Units marked with resistance code, 2 digit date code, model designation and pin numbers

ST-5W
Gull Wing
Top Adjust


1.00 mm (.040) TYP. 3 PLCS.
0.50 mm (.020) TYP. 3 PLCS.
0.40 mm (.016) MIN. FLATTENED LENGTH TYP. 3 PLCS.
6.75 mm (.266)
ST-5
6.00 mm (.240)
1.00 mm (.040)
1.80 mm (.065) DIA. SHAFT HEAD
SLOT 0.60 mm (.025) WIDE X 0.80 mm (.030) DEEP.
4.30 mm (.170)
2.50 mm (.100) TYP.
1.00 mm (.040)
0.90 mm (.035)
1.50 mm (.059) TYP. 3 PLCS.
1.50 mm (.059) TYP. 3 PLCS.
5.80 mm (.228) TYP.
2.50 mm (.100) TYP.

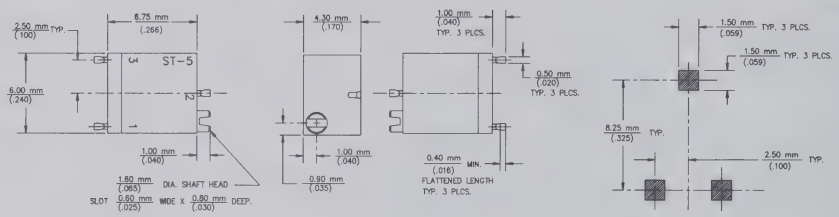
Suggested Land Pattern

ST-5X
Gull Wing
Side Adjust


1.00 mm (.040) TYP. 3 PLCS.
0.50 mm (.020) TYP. 3 PLCS.
0.40 mm (.016) MIN. FLATTENED LENGTH TYP. 3 PLCS.
6.75 mm (.266)
ST-5
6.00 mm (.240)
0.90 mm (.035)
1.00 mm (.040)
1.60 mm (.065) DIA. SHAFT HEAD
SLOT 0.60 mm (.025) WIDE X 0.80 mm (.030) DEEP.
1.00 mm (.040)
2.50 mm (.100) TYP
4.30 mm (.170)
1.50 mm (.059) TYP. 3 PLCS.
1.50 mm (.059) TYP. 3 PLCS.
5.80 mm (.228) TYP.
2.50 mm (.100) TYP.

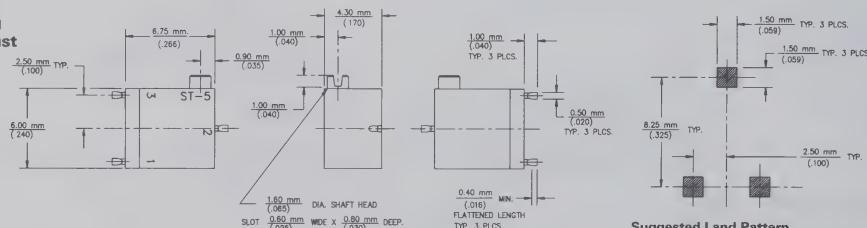
Suggested Land Pattern

ST-5P
Gull Wing
Side Adjust

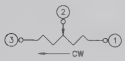

2.50 mm (.100) TYP.
6.75 mm (.266)
ST-5
6.00 mm (.240)
1.00 mm (.040)
1.80 mm (.065) DIA. SHAFT HEAD
SLOT 0.60 mm (.025) WIDE X 0.80 mm (.030) DEEP.
4.30 mm (.170)
1.00 mm (.040)
0.90 mm (.035)
1.00 mm (.040) TYP. 3 PLCS.
0.50 mm (.020) TYP. 3 PLCS.
0.40 mm (.016) MIN. FLATTENED LENGTH TYP. 3 PLCS.
1.50 mm (.059) TYP. 3 PLCS.
1.50 mm (.059) TYP. 3 PLCS.
8.25 mm (.325) TYP.
2.50 mm (.100) TYP.

Suggested Land Pattern

ST-5R
Gull Wing
Side Adjust


2.50 mm (.100) TYP.
6.75 mm (.266)
ST-5
6.00 mm (.240)
0.90 mm (.035)
1.00 mm (.040)
4.30 mm (.170)
1.00 mm (.040)
1.60 mm (.065) DIA. SHAFT HEAD
SLOT 0.60 mm (.025) WIDE X 0.80 mm (.030) DEEP.
1.00 mm (.040) TYP. 3 PLCS.
0.50 mm (.020) TYP. 3 PLCS.
0.40 mm (.016) MIN. FLATTENED LENGTH TYP. 3 PLCS
1.50 mm (.059) TYP. 3 PLCS.
1.50 mm (.059) TYP. 3 PLCS.
8.25 mm (.325) TYP.
2.50 mm (.100) TYP.

Suggested Land Pattern

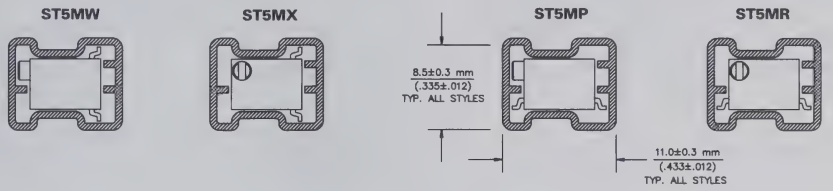


Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).
3. See packaging options on following pages for packaging dimensions.

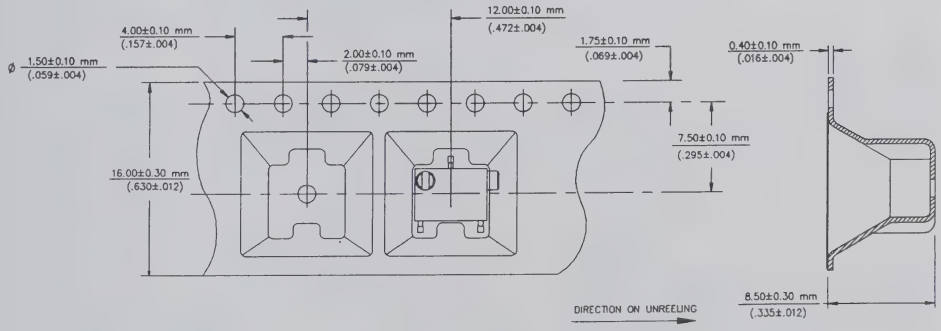
ST-5M

Magazine Packaging Dimensions
Each Magazine Contains 50 Units and Is 380 ± 2 mm (14.96 ± .079) Long.



ST5TW
ST5TX

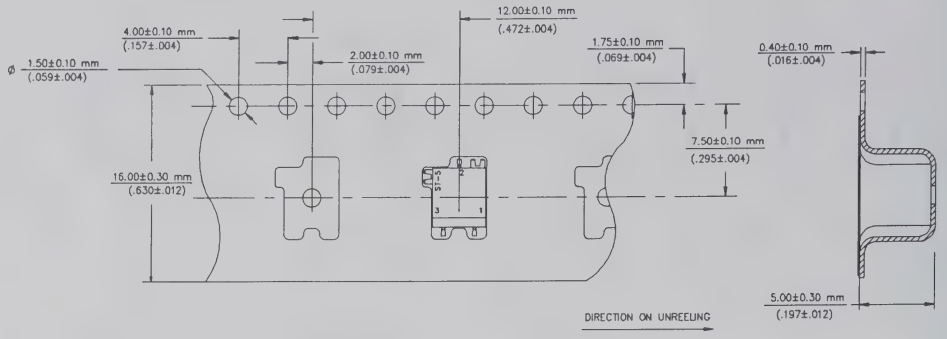
Tape Dimensions
12 mm Pitch On 16 mm Tape.
Units Packaged 500 Per Reel.
Conforms to EIA-481-A Standard for Surface Mount Components.



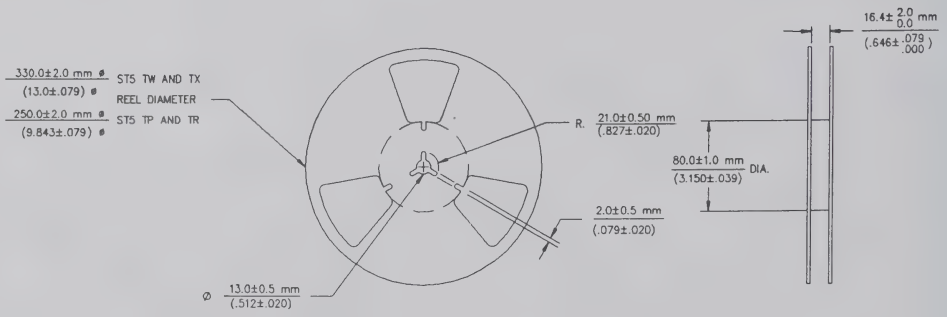
Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).

ST5TP
ST5TR
Tape Dimensions
12 Pitch on 16 mm Tape
Units Packaged 500 Per Reel.
Conforms to EIA-481-A Standard for Surface Mount Components.

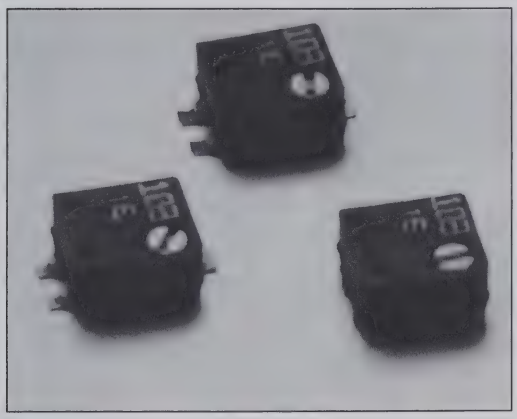


Reel Dimensions
ST5 TW and TX on 330 mm (13 Inch) Dia. Reel.
ST5 TP and TR on 250 mm (10 Inch) Dia. Reel.



Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).



Surface Mount Trimming Potentiometer, 7 mm Square Multiturn, Cermet Model ST-7

Features

- Sealed to Allow for Automatic Processing
- Precious Metal Alloy Contact
- Tape and Reel and Bulk Packaging

Specifications

Electrical

Resistance Range	: 50 Ohms to 1 Meg. Ohms
Resistance Tolerance	: ±20% Standard
Temp. Coeff. of Resistance	: 100 Ohms to 1 Meg. ±100 ppm/°C 50Ω ±250 ppm/°C
Power Rating	: 1/4 Watt at 70°C
Operating Voltage Max.	: 200 VDC or power rating, whichever is less.
Wiper Current Max.	: 100 mA or power rating, whichever is less.
Electrical Angle, Nominal	: 2.5 Turns Nominal.
Electrical Continuity	: Continuous over full mechanical range.
End Resistance	: 1% or 3 Ohms, whichever is greater.
Resolution	: Essentially infinite.
Contact Resistance Variation	: 1% or 3 Ohms, whichever is greater.
Operating Temp. Range	: −55°C to 125°C.
Insulation Resistance, Min.	: Min. 1000 Meg. at 500 VDC for 2 min.
Dielectric Strength	: 500 VAC rms, 1 minute, 1 milliamp max.

Mechanical

Mechanical Angle, Nominal	: 3 Turns Nominal
Operating Torque	: 50 gram-cm (0.70 oz-in.) max.
Stop Strength, Min.	: Not applicable, wiper idles
Rotational Life	: 100 cycles (▲ R/R ≤ 2.0Ω + 3%)

Environmental (MIL-R-22097)

Thermal Shock: (−65°C to 125°C)	▲ R/R ≤ 2.00% ▲ SS ≤ 1.00%
Humidity: (80 ~ 98% Rh, 240 hrs.)	▲ R/R ≤ 2.00%
Mech. Shock: (100 g)	▲ R/R ≤ 1.00% ▲ SS ≤ 1.00%
Vibration: (20 g, 10 to 2000 Hz.)	▲ R/R ≤ 1.00% ▲ SS ≤ 1.00%
Low Temp. Operation: (−55°C, 2 hrs.)	▲ R/R ≤ 2.00% ▲ SS ≤ 2.00%
High Temp. Exposure: (125°C, 250 hrs.)	▲ R/R ≤ 3.00% ▲ SS ≤ 2.00%
Load Life: (70°C, 0.25 W, 1000 hrs.)	▲ R/R ≤ 3.00% ▲ SS ≤ 1.00%
Soldering Heat: (215°C, 35 sec. or 260°C, 10 sec.)	▲ R/R ≤ 1.00%
Immersion: Fluorocarbon Liquid, 85°C, 1 min.	No Leaks

Standard Resistance Values and Codes

Ω	Code	Ω	Code
50	500	10 K	103
100	101	20 K	203
200	201	50 K	503
500	501	100 K	104
1 K	102	200 K	204
2 K	202	500 K	504
5 K	502	1 M	105

Part Number

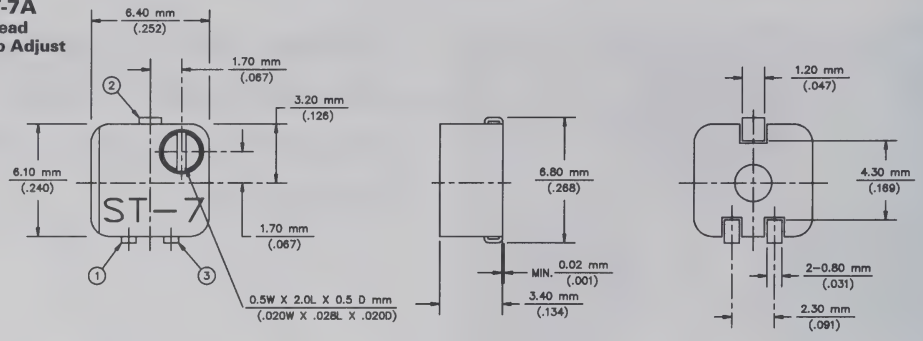
ST7 A 103

Model
Package Option
Blank = Bulk Pack
T = Tape and Reel/500 Units
Pin Style
Resistance Code

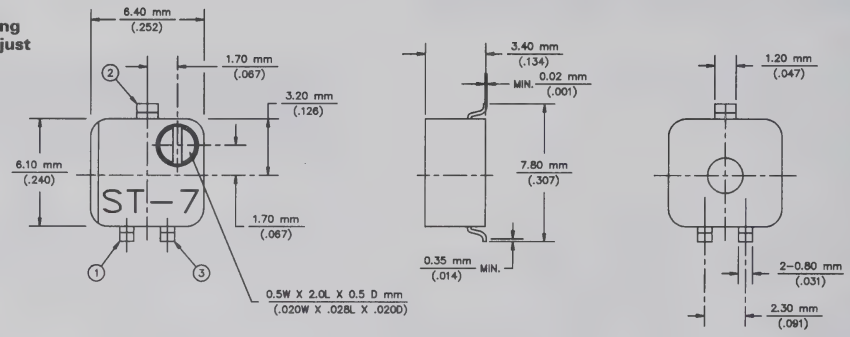
Marking

Units marked with resistance code, and 2 digit date code and model designation refer to Model ST-5 for Tape and Reel Dimensions.

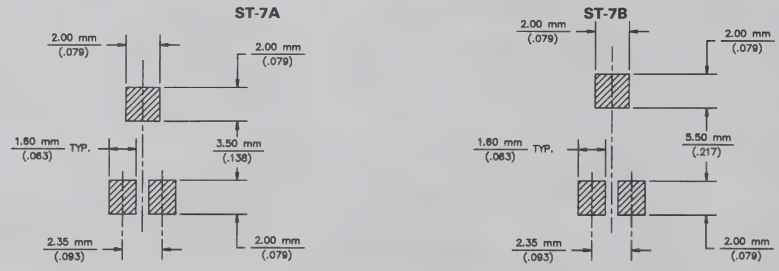
ST-7A
J Lead
Top Adjust

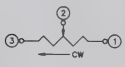


ST-7B
Gull Wing
Top Adjust



Suggested Land Patterns





Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).

Soldering Process Application Recommendations for Sealed Surface Mount Components

Mepcopal's sealed surface mount components are designed to withstand the processes related to infrared and vapor phase reflow, as well as dual wave soldering. They are sealed against flux entrapment by means of an O-ring seal (or multiple chevron press fit in the case of multiturn devices) and utilizes materials that can withstand exposure to all commonly used defluxing solvents. The design of these components presupposes the process conditions and materials listed below.

Flux and Solder:

While solderability is tested with R type flux, use of all fluxes of all levels of activity is possible when processing Mepcopal sealed surface mount devices (from R type flux OA); however, as in all soldering applications, it is advisable not to use flux of an activity level greater than that necessary to achieve optimum yields for solder wetting.

Fluxes of RA and OA activity levels are active (i.e. corrosive) at room temperatures and therefore must be removed by a thorough cleaning process. It is recommended that all types of fluxes be removed by cleaning because of the possibility of future exposure to elevated temperatures.

Suggested solder compositions are Sn63/Pb37, Sn60/Pb40, or Sn62/Pb36/Ag2, with Sn63/Pb37 preferred. Typical solder paste print thickness would be .008 to .010 inches thick.

Reflow of Solder and Soldering:

Normal preheating used to activate flux and minimize thermal shock to components is required. Temperature slopes (gradients) when measured at the component side of the board should be kept to below 180°C per minute.

- Dual Wave Soldering—230°C to 260°C solder temperature for a period not more than 10 seconds (5 seconds recommended).
- IR Reflow Soldering—220°C to 240°C case temperature for a period not more than 30 seconds (15 seconds recommended).
- Vapor Phase Reflow—vapor with 215°C condensation temperature for a period not more than 3 minutes (120 seconds recommended).

Cleaning:

An appropriate cooling down time is necessary after soldering and before exposure to defluxing solvents. The temperature of the component body when exposed to cleaning should not exceed 70°C.

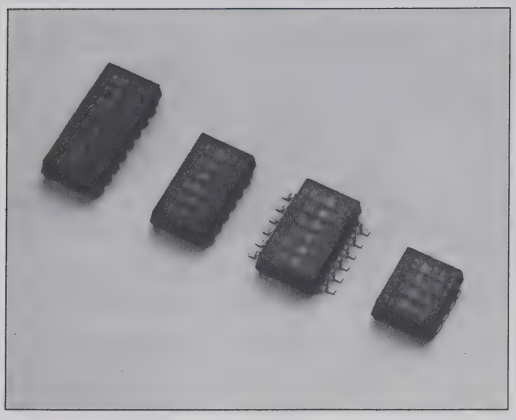
Cleaning can be accomplished by ultrasonic (vapor side and ultrasonic tank, up to 5 minutes, 1 minute recommended) or spray rinse with temperatures on the order of 65°C and pressures of not greater than 80 psi 5.5 Kg-cm^2) for a period not to exceed 20 seconds.

Appropriate defluxing solvents are:

- 1-1-1 Trichloroethane
- Aqueous detergent solutions
- Terpene based semiaqueous
- Freon (TE, TMS, TF)
- Methanol

Adjustment:

Adjustment of components should be performed only after adequate cooling to allow temperature stabilization and evaporation of solvents (approximately 5 to 6 minutes at room temperature after defluxing).



Surface Mount Slide Switch .050″ Lead Pitch Model CHS

Features

- Tape Sealed to Allow for Automatic Processing
- Gull Wing and J Lead
- Highly Automated Assembly
- Bulk or Tape and Reel Packaging

Specifications

General

Operating Temp. Range : −40°C to +85°C
Storage Temp. Range : −40°C to +85°C
Sealing Method : Top tape

Electrical

Contact Rating
Non-Switching : 100 mA @ 50 VDC max.
Switching : 25 mA @ 24 VDC max. 100 mA @ 6 VDC max.
Contact Resistance : 50 mΩ max. @ 1KHz, 1.5 mA, 20 mV max.
Insulation Resistance : 1,000 MΩ min. @ 100 VDC for 60 sec.
Dielectric Strength : 0.5 mA max. 500 VAC @ 50 Hz for 60 sec.

Mechanical

Operating Force : 1.0 kgf max.
Rotational Life : 2,000 cycles

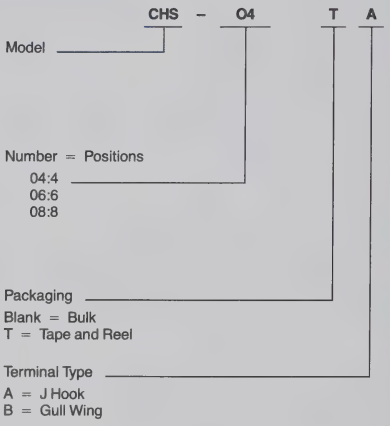
Environmental (MIL-STD-202)

Thermal Shock: (−40°C to +85°C, 30 Min. Dwell, 5 Cycles)	See Criteria Note Below
Temp./Humidity: (−10°C to +65°C, 0 ~ 96% Rh, 24 hrs., 10 Cycles)	See Criteria Note Below
Low Temp. Storage: (−40°C, 96 hrs.)	See Criteria Note Below
High Temp. Storage: (85°C, 96 hrs.)	See Criteria Note Below
Mechanical Life: (2000 cycles @ 0 Load or 100 mA,6 VDC)	See Criteria Note Below
Soldering Heat: (240°C, 10 sec.)	See Criteria Note Below
Mechanical Shock: (50 g, 11 mS, Semi-Sine Wave, 6 Axes, 3 Cycles)	Contact Bounce 10μS Max.
Vibration: (10 g, .060 DA, 10 to 500 Hz, 2 hrs., 3 Axes)	Contact Bounce 10μS Max.

Criteria Note

Contact resistance not greater than 50 mΩ
Insulation resistance not less than 1,000 MΩ
Operating force not greater than 1.0 kgf

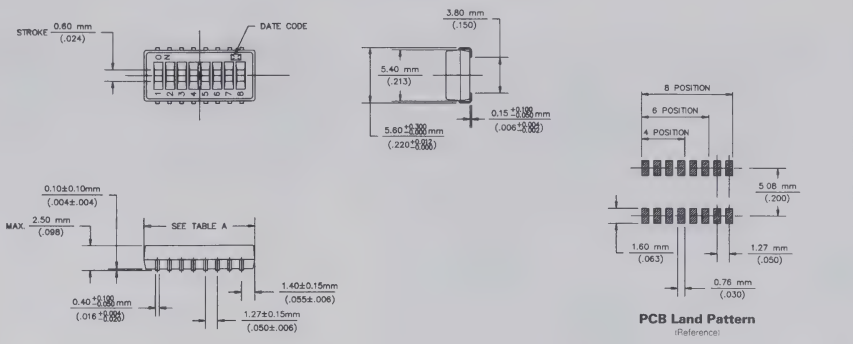
Part Number



Marking

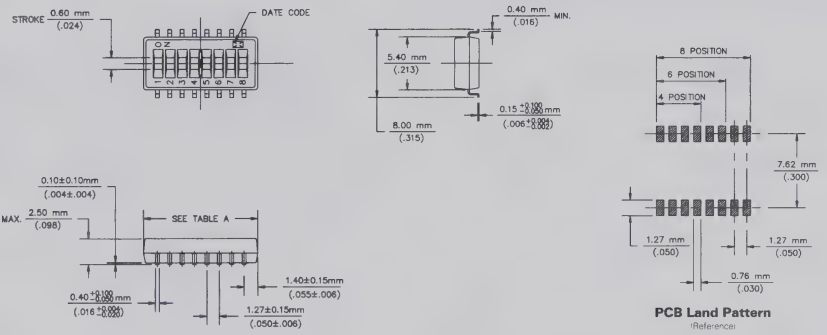
Units marked with two digit date code, switch position marks

J-Hook
Lead Style (A)



PCB Land Pattern
(Reference)

Gull-Wing
Lead Style (B)



PCB Land Pattern
(Reference)

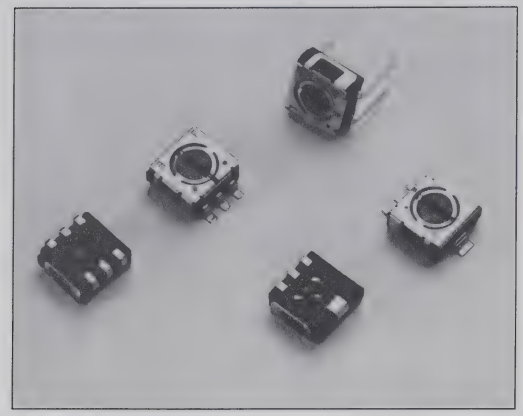
Schematic

Table A

NUMBER OF POSITIONS	ASSEMBLY LENGTH
4	6.60 mm (.260)
6	9.20 mm (.362)
8	11.70 mm (.461)

Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).



Surface Mount Selector Switch, 4 mm Square Model CS-4

Features

- Sealed to Allow for Automatic Processing
- Gull Wing and J Lead
- Highly Automated Assembly
- Bulk or Tape and Reel Packaging

Specifications

General

Operating Temp. Range	: −25°C to +70°C
Storage Temp. Range	: −40°C to +70°C
Sealing Method	: O Ring Sealed

Electrical

Contact Rating	: DC 0.5 VA
Maximum Current	: 100 mA max.
Maximum Voltage	: 16 VDC
Contact Resistance	: 100 mΩ max. @ 1KHz, 20 mV
Insulation Resistance	: 100 MΩ min. @ 500 VDC
Dielectric Strength	: 1 mA max. 500 VAC @ 50 Hz for 60 sec.

Mechanical

Shaft Torque	: 100 g-cm (1.39 oz.-in.) max.
Number of Positions	: 3
Step Angle	: 45°
Rotational Life	: 200 Cycles min.
Stop Strength	: 250 g-cm (3.47 oz.-in.) min.

Environmental (MIL-STD-202)

Thermal Shock: (−40°C to +70°C, 30 min. Dwell, 5 Cycles)	See Criteria Note Below
Humidity: (90 ~ 95% Rh, 40°C, 48 hrs.)	See Criteria Note Below
Low Temp. Storage: (−40°C, 16 hrs.)	See Criteria Note Below
High Temp. Storage: (70°C, 16 hrs.)	See Criteria Note Below
Rotational Life: (200 Cycles @ 0 Load or 30 mA, 16 VDC)	See Criteria Note Below
Soldering Heat: (260°C, 10 Sec.)	See Criteria Note Below
Mechanical Shock: (50 g, 11 mS, Sawtooth, 6 Axes, 3 Cycles)	Contact Bounce 0.1 mS Max.
Vibration: (10 g, .060 DA, 10 to 55 Hz, 2 hrs., 3 Axes)	Contact Bounce 0.1 mS Max.
Immersion: Fluorocarbon Liquid, 85°C, 1 min.	No Leaks

Criteria Note

Contact Resistance not greater than 100 mΩ
Insulation Resistance not less than 100 MΩ
(10 MΩ for Humidity)

Part Number

CS-4 1 3 N T A

Model

No. of Poles
1 = 1 Pole
2 = 2 Pole

No. of Contacts (Throws)
2 = 2 Contacts
3 = 3 Contacts

Contact Timing
N = Non-Shorting (1 Pole 3 Contacts)
Y = Non-Shorting with Neutral Detent (1 Pole 2 Contacts, 2 Pole 2 Contacts)

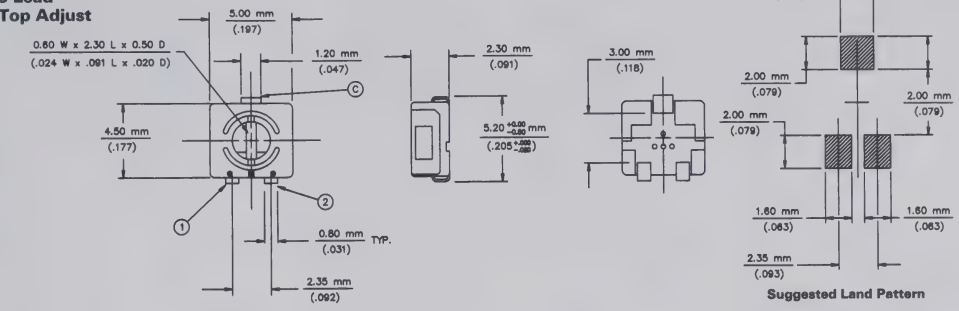
Packaging
None = Bulk
T = Tape and Reel/500 Units

Terminal Type
A = J Hook
B = Gull Wing
C = Thru Hole (1 Pole 2 Contact Only)

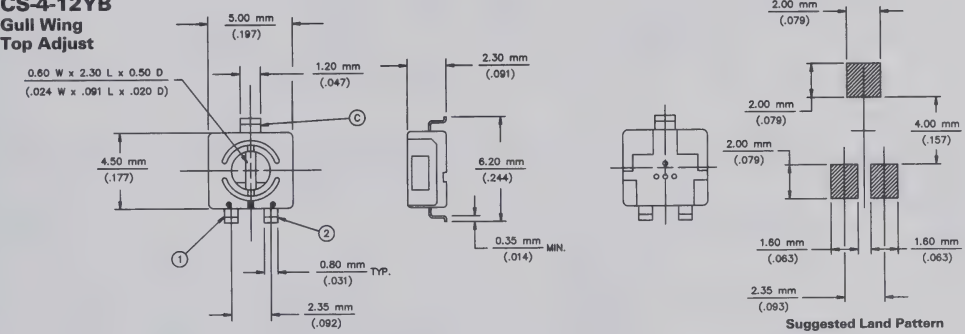
Marking

Units marked with two digit date code and switch position marks

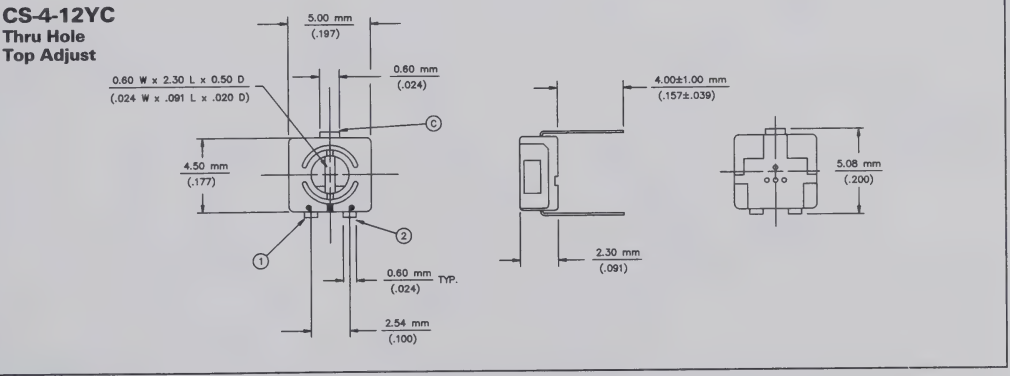
CS-4-12YA
J Lead
Top Adjust



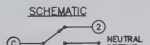
CS-4-12YB
Gull Wing
Top Adjust



CS-4-12YC
Thru Hole
Top Adjust



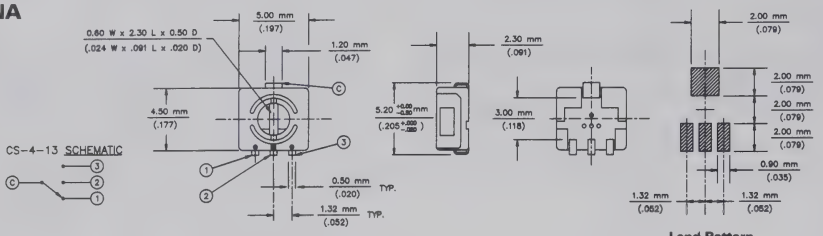
SCHEMATIC



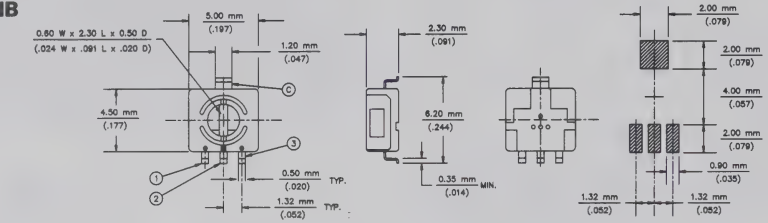
Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).
3. See packaging options on following pages for packaging dimensions.

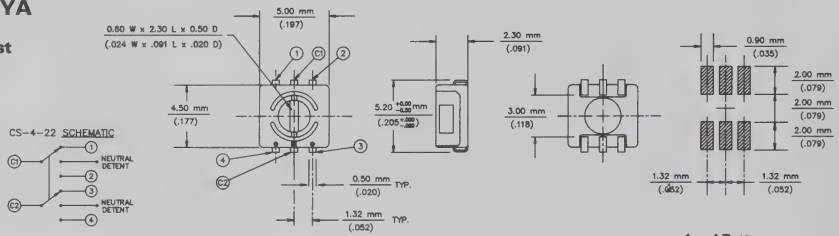
CS-4-13NA
J Lead
Top Adjust



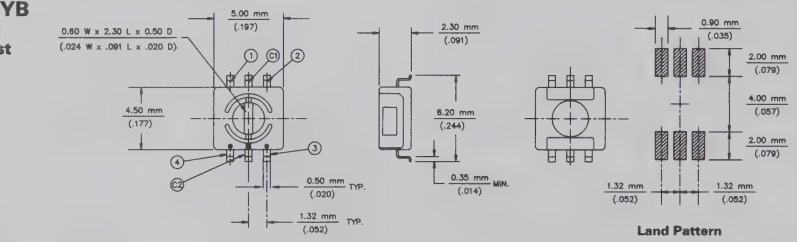
CS-4-13NB
Gull Wing
Top Adjust



CS-4-22YA
J Lead
Top Adjust



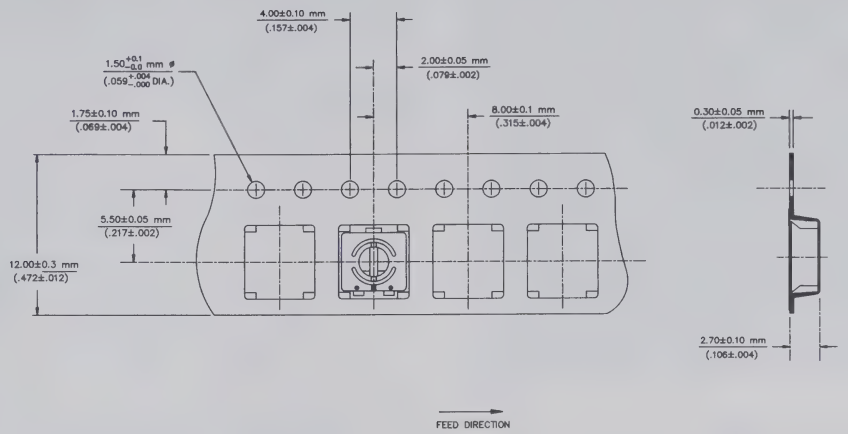
CS-4-22YB
Gull Wing
Top Adjust



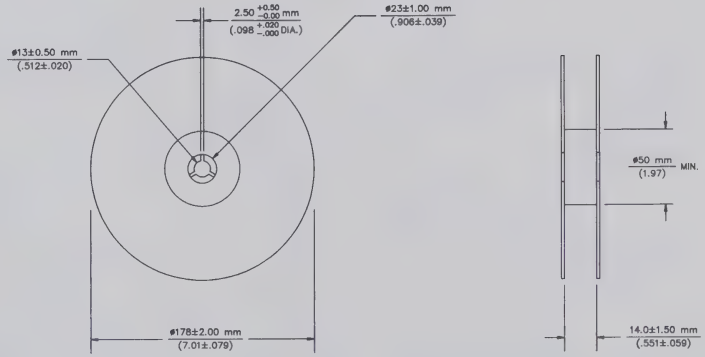
Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).
3. See packaging options on following pages for packaging dimensions.

CS-4
Tape Dimensions

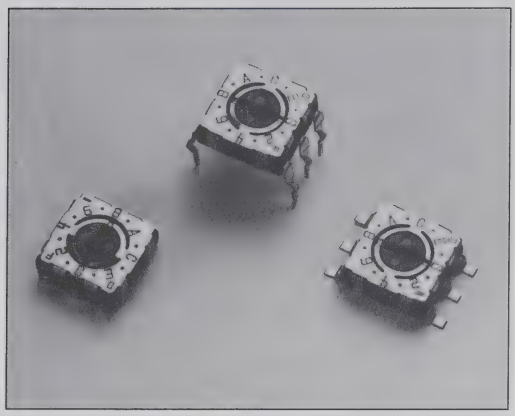


CS-4
Reel Dimensions



Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).



Surface Mount Coded Switch 7 mm Square Model S-7000

Features

- Hexadecimal or Decimal to Binary
- Sealed to Allow for Automatic Processing
- Gull Wing and J Lead or Leaded
- Highly Automated Assembly
- Bulk or Tape and Reel Packaging

Specifications

General

Operating Temp. Range	: −25°C to +70°C
Storage Temp. Range	: −25°C to +70°C
Sealing Method	: O Ring Sealed

Electrical

Contact Rating	
Non-Switching	: 100 mA @ 50 VDC max.
Switching	: 100 mA @ 5 VDC max.
Contact Resistance	: 100 mΩ max. @ 1KHz, 20 mV
Insulation Resistance	: 100 MΩ min. @ 100 VDC
Dielectric Strength	: 1 mA max. 250 VAC @ 50 Hz for 60 sec.

Mechanical

Shaft Torque	: 200 g-cm (2.78 oz.-in.) max.
Number of Positions	: 10 (decimal), 16 (hex)
Step Angle	: 36° (decimal), 22.5° (hex)
Rotational Life	: 10,000 steps min.

Environmental

Thermal Shock:	
(−25°C to +70°C, 30 Min. Dwell, 5 Cycles)	See Criteria Note Below
Humidity: (90 ~ 95% Rh, 40°C, 240 hrs.)	See Criteria Note Below
Low Temp. Storage: (−25°C, 96 hrs.)	See Criteria Note Below
High Temp. Storage: (70°C, 96 hrs.)	See Criteria Note Below
Rotational Life:	
(10,000 Steps @ 0 Load or 100 mA, 5 VDC)	See Criteria Note Below
Soldering Heat: (260°C, 10 sec.)	See Criteria Note Below
Mechanical Shock:	
(50 g, 11 mS, Sawtooth, 6 Axes, 3 Cycles)	Contact Bounce 0.1mS max.
Vibration:	
(10 g, .060 DA, 10 to 500 Hz, 2 hrs., 3 Axes)	Contact Bounce 0.1mS max.
Immersion: Fluorocarbon Liquid, 85°C, 1 min.	No Leaks

Criteria Note

Contact Resistance not greater than 100 mΩ
Insulation Resistance not less than 100 MΩ (10 MΩ Humidity)
Shaft Torque not greater than 200 g-cm

Part Number

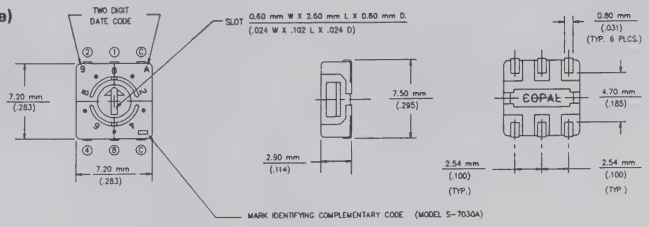
S7 0 1 0 T A

- Model
- Shaft Type
  - 0 = Flush
- Code Type
  - 1 = Decimal Reel
  - 3 = Decimal Complementary
  - 5 = Hexadecimal Reel
  - 7 = Hexadecimal Complementary
- Adjustment
  - O = Top
- Packaging
  - Blank = Bulk
  - T = Tape and Reel
- Terminal Type
  - A = J Hook
  - B = Gull Wing
  - C = Thru Hole

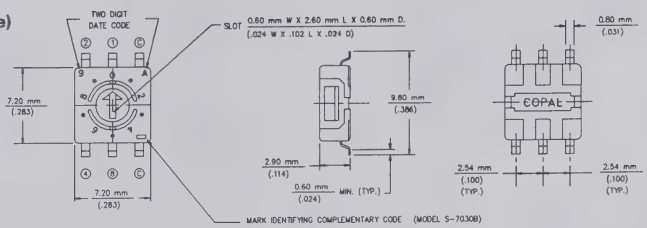
Marking

Units marked with two digit date code, mark for complementary code, switch position marks

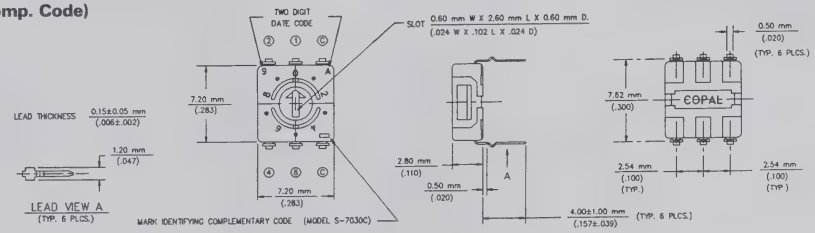
S-7010A (Real Code)
S-7030A (Comp. Code)
J Lead
Decimal


TWO DIGIT DATE CODE
SLOT 0.60 mm W X 2.60 mm L X 0.60 mm D. (.024 W X .102 L X .024 D)
0.80 mm (.031) (TYP. 6 PLCS.)
7.20 mm (.283)
7.50 mm (.295)
4.70 mm (.185)
2.90 mm (.114)
2.54 mm (.100) (TYP.)
2.54 mm (.100) (TYP.)
COPAL
MARK IDENTIFYING COMPLEMENTARY CODE (MODEL S-7030A)

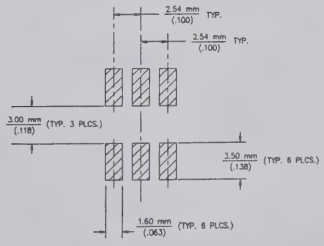
S-7010B (Real Code)
S-7030B (Comp. Code)
Gull Wing
Decimal


TWO DIGIT DATE CODE
SLOT 0.60 mm W X 2.60 mm L X 0.60 mm D. (.024 W X .102 L X .024 D)
0.80 mm (.031)
7.20 mm (.283)
9.80 mm (.386)
2.90 mm (.114)
0.60 mm (.024) MIN. (TYP.)
2.54 mm (.100) (TYP.)
2.54 mm (.100) (TYP.)
COPAL
MARK IDENTIFYING COMPLEMENTARY CODE (MODEL S-7030B)

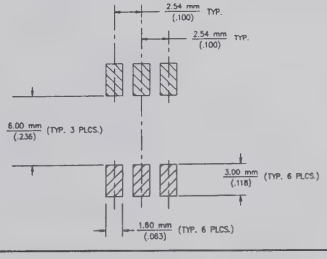
S-7010C (Real Code)
S-7030C (Comp. Code)
Thru Hole
Decimal


TWO DIGIT DATE CODE
SLOT 0.60 mm W X 2.60 mm L X 0.60 mm D. (.024 W X .102 L X .024 D)
0.50 mm (.020) (TYP. 6 PLCS.)
LEAD THICKNESS 0.15±0.05 mm (.006±.002)
1.20 mm (.047)
LEAD VIEW A (TYP. 6 PLCS.)
7.20 mm (.283)
7.62 mm (.300)
2.80 mm (.110)
0.50 mm (.020)
A
2.54 mm (.100) (TYP.)
2.54 mm (.100) (TYP.)
4.00±1.00 mm (.157±.039) (TYP. 6 PLCS.)
COPAL
MARK IDENTIFYING COMPLEMENTARY CODE (MODEL S-7030C)

Suggested Land Pattern
S-7010A
S-7030A



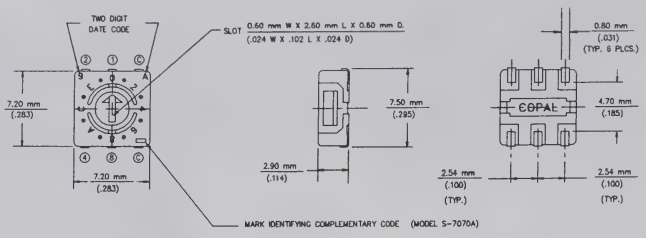
Suggested Land Pattern
S-7010B
S-7030B



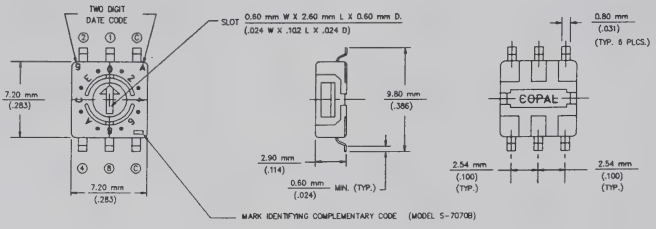
Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).
3. See packaging options on following pages for packaging dimensions.

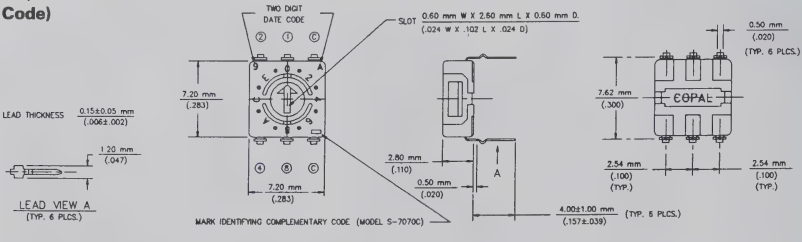
S-7050A (Real Code)
S-7070A (Comp. Code)
J Lead
Hexadecimal


TWO DIGIT DATE CODE
SLOT 0.60 mm W X 2.60 mm L X 0.60 mm D. (.024 W X .102 L X .024 D)
7.20 mm (.283)
7.20 mm (.283)
7.50 mm (.295)
2.90 mm (.114)
0.80 mm (.031) (TYP. 6 PLCS.)
4.70 mm (.185)
2.54 mm (.100) (TYP.)
2.54 mm (.100) (TYP.)
MARK IDENTIFYING COMPLEMENTARY CODE (MODEL S-7070A)

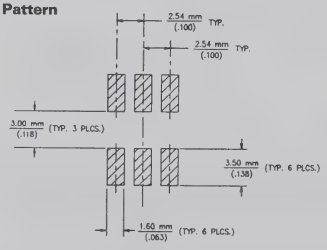
S-7050B (Real Code)
S-7070B (Comp. Code)
Gull Wing
Hexadecimal


TWO DIGIT DATE CODE
SLOT 0.60 mm W X 2.60 mm L X 0.60 mm D. (.024 W X .102 L X .024 D)
7.20 mm (.283)
7.20 mm (.283)
9.80 mm (.386)
2.90 mm (.114)
0.60 mm (.024) MIN. (TYP.)
0.80 mm (.031) (TYP. 6 PLCS.)
2.54 mm (.100) (TYP.)
2.54 mm (.100) (TYP.)
MARK IDENTIFYING COMPLEMENTARY CODE (MODEL S-7070B)

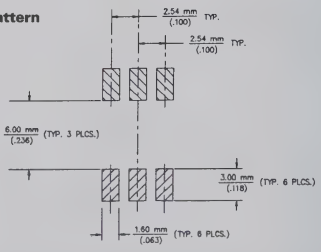
S-7050C (Real Code)
S-7070C (Comp. Code)
Thru Hole
Hexadecimal


LEAD THICKNESS 0.15±0.05 mm (.006±.002)
1.20 mm (.047)
LEAD VIEW A (TYP. 6 PLCS.)
TWO DIGIT DATE CODE
SLOT 0.60 mm W X 2.60 mm L X 0.60 mm D. (.024 W X .102 L X .024 D)
7.20 mm (.283)
7.20 mm (.283)
2.80 mm (.110)
0.50 mm (.020)
A
0.50 mm (.020) (TYP. 6 PLCS.)
7.62 mm (.300)
2.54 mm (.100) (TYP.)
2.54 mm (.100) (TYP.)
4.00±1.00 mm (.157±.039) (TYP. 5 PLCS.)
MARK IDENTIFYING COMPLEMENTARY CODE (MODEL S-7070C)

Suggested Land Pattern
S-7050A
S-7070A

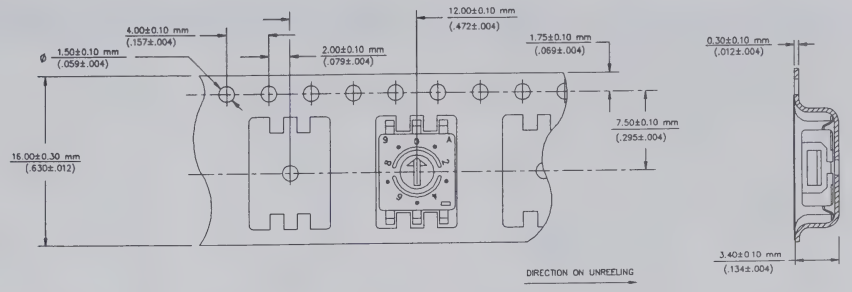


Suggested Land Pattern
S-7050B
S-7070B



Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).
3. See packaging options on following pages for packaging dimensions.



Tape Dimensions

EIA-481-Designation

Flange Diameter	**A**	**250 ± 2 mm**	**(9.843 ± .079)**
Hub Diameter	**N**	**80 ± 1 mm**	**(3.150 ± .039)**
Hub Inside Diameter	**C**	**13 ± 0.5 mm**	**(.512 ± .020)**
Drive Spoke Diameter	**D**	**21 ± 0.8 mm**	**(.827 ± .031)**
Drive Spoke Width	**B**	**2 ± 0.5 mm**	**(.079 ± .020)**
Total Reel Thickness	**T**	**16.4 +2/–0 mm**	**(.646 + .079/–0)**

Reel Dimensions

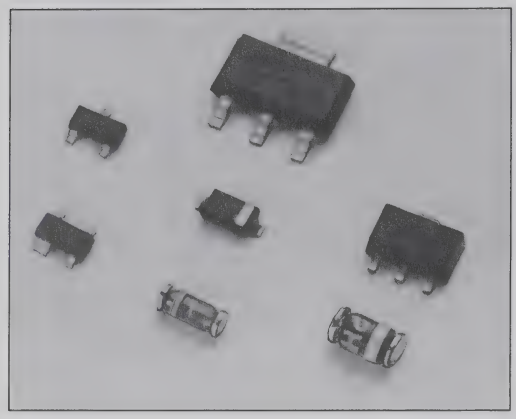
		SELECTOR POSITION															
		16 POSITION, BINARY CODED HEXADECIMAL (BCH)															
		10 POSITION, BINARY CODED DECIMAL (BCD)															
	PIN	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
REAL CODE	1		●		●		●		●		●		●		●		●
	2			●	●			●	●			●	●			●	●
	4					●	●	●	●					●	●	●	●
	8									●	●	●	●	●	●	●	●
COMPLEMENTARY CODE	1	●		●		●		●		●		●		●		●	
	2	●	●			●	●			●	●			●	●		
	4	●	●	●	●					●	●	●	●				
	8	●	●	●	●	●	●	●	●								

● CONTACT CLOSED

Code Format

Metric

1. Dimensions are in millimeters (inches in parentheses are for reference only).
2. Tolerances unless otherwise specified +/- 0.30 mm (+/- .012 inches).



Surface Mount Transistors and Diodes

A pioneer in Surface Mount products, Philips invented the SOT-23 industry standard SM package. Offering full expertise and innovation in Surface Mount technology, Philips has introduced the newest medium-power one-watt SM package, the SOT-223 and has the broadest product range in SOT-89, SOT-143, and MELF diode packages.

Our Surface Mount devices, as with all our discrete semiconductors, are tested and manufactured to consistently high quality control standards. Both bulk and tape-and-reel packaging are available; our tape-and-reel packaging conforms to EIA-RS481A and IEC286-3 specifications.

The SOT-223 is the first surface mount package for discrete semiconductors that can safely dissipate up to one watt on standard PCBs at an ambient temperature of 60°C. Expertly designed to handle high frequency applications, the SOT-223 package is especially useful in mobile communications equipment, VLSI test equipment, and anywhere else where greater power dissipation or low thermal impedance is a concern.

Diodes
General Purpose/ Switching
Bandswitch
Variable Capacitance
Schottky
Rectifier
Voltage Reference
Zeners

Transistors
General Purpose/ Switching
Darlington
High Frequency
Wideband
Low Noise
High Voltage
FET's

Temperature Sensors

Trigger Devices

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BA582	175	BC817-16	140	BCW30	144	BF767	153	BFT93	155	BSR33	147
BA682	175	BC817-25	140	BCW31	140	BF820	160	BRY61	170	BSR40	147
BA683	175	BC817-40	140	BCW32	140	BF821	160	BRY62	170	BSR41	147
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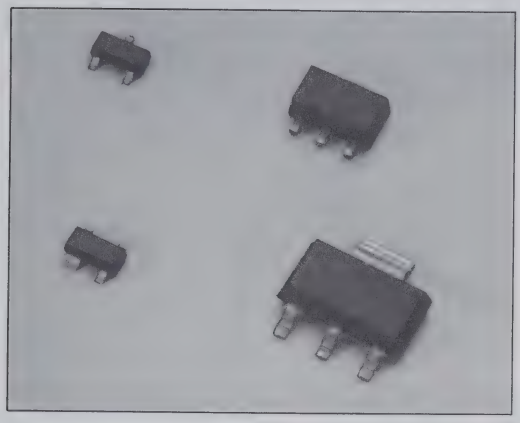
BAS19	172	BC818-40	140	BCW60B	140	BF824	153	BSN20	164	BSR56	163
BAS20	172	BC846A	140	BCW60C	140	BF840	153	BSP15	160	BSR57	163
BAS21	172	BC846B	140	BCW60D	140	BF841	153	BSP16	160	BSR58	163
BAS28	172	BC847A	140	BCW61A	144	BF989	163	BSP19	160	BSS63	147
BAS29	172	BC847B	140	BCW61B	144	BF990	163	BSP20	160	BSS64	147
BAS31	172	BC847C	140	BCW61C	144	BF990A	163	BSP30	147	BSS83	163
BAS32L	172	BC848A	140	BCW61D	144	BF9144	163	BSP31	147	BSS192	164
BAS35	172	BC848B	140	BCW69	144	BF992	163	BSP32	147	BST15	160
BAS56	172	BC848C	140	BCW70	144	BF9147S	163	BSP33	147	BST16	160
BAS85	179	BC849B	158	BCW71	140	BF996S	163	BSP40	147	BST39	160
BAS86	179	BC849C	158	BCW72	140	BF9150	163	BSP41	147	BST40	160
BAT17	179	BC850B	158	BCW81	140	BF998	163	BSP42	147	BST50	150
BAT18	175	BC850C	158	BCW89	144	BFG16A	155	BSP43	147	BST51	150
BAT54	179	BC856A	144	BCX17	144	BFG17A	155	BSP50	150	BST52	150
BAT54A	179	BC856B	144	BCX18	144	BFG25AX	155	BSP52	150	BST60	150
BAT54C	179	BC857A	144	BCX19	140	BFG31	155	BSP60	150	BST61	150
BAT54S	179	BC857B	144	BCX20	140	BFG33	155	BSP61	150	BST62	150
BAT74	179	BC857C	144	BCX51	144	BFG35	155	BSP62	150	BST80	164
BAV23	172	BC858A	144	BCX52	144	BFG55	155	BSP103	164	BST82	164
BAV70	172	BC858B	144	BCX53	144	BFG67	155	BSP105	164	BST84	164
BAV74	172	BC858C	144	BCX54	140	BFG92A	155	BSP106	164	BST86	164
BAV99	172	BC859A	158	BCX55	140	BFG93A	155	BSP160	164	BST120	164
BAV153	172	BC859B	158	BCX56	140	BFG147	155	BSP108	164	BST122	164
BAV101	172	BC859C	158	BCX70G	140	BFG150	155	BSP109	164	BSV52	147
BAV155	172	BC860A	158	BCX70H	140	BFG135	155	BSP163	164	BYD17	181
BAV103	172	BC860B	158	BCX70J	140	BFG1150	155	BSP120	164	BYD17D	181
BAV158	172	BC860C	158	BCX70K	140	BFG198	155	BSP121	164	BYD17G	181
BAV23S	172	BC868	140	BCX71G	144	BFQ17	155	BSP122	164	BYD17J	181
BAW56	172	BC869	144	BCX71H	144	BFQ18A	155	BSP126	164	BYD17K	181
BB215	177	BCF29	158	BCX71J	144	BFQ19	155	BSP128	164	BYD17M	181
BB219	177	BCF30	158	BCX71K	144	BFQ67	155	BSP205	164	BYD37	181
BB240	177	BCF32	158	BF510	163	BFQ149	155	BSP206	164	BYD37D	181
BB241	177	BCF33	158	BF511	163	BFR101A	163	BSP220	164	BYD37G	181
BB249	177	BCF70	158	BF512	163	BFR101B	163	BSP225	164	BYD37J	181
BB515	177	BCF81	158	BF513	163	BFR30	163	BSR12	147	BYD37K	181
BB619	177	BCP51	144	BF536	153	BFR31	163	BSR13	147	BYD37M	181
BB620	177	BCP52	144	BF545	163	BFR53	155	BSR14	147	BYD77	181
BB804	177	BCP53	144	BF550	153	BFR92	155	BSR15	147	BYD77A	181
BB811	177	BCP54	140	BF569	153	BFR92A	155	BSR16	147	BYD77B	181
BBY31	177	BCP55	140	BF579	153	BFR93	155	BSR17	147	BYD77C	181
BBY39	177	BCP56	140	BF620	160	BFR93A	155	BSR17A	147	BYD77D	181
BBY40	177	BCP68	140	BF621	160	BFR106	155	BSR18	147	BYD77E	181
BBY42	177	BCP69	144	BF622	160	BFS17	155	BSR18A	147	BYD77F	181
BBY62	177	BCV26	150	BF623	160	BFS17A	155	BSR19	160	BYD77G	181
BC807-16	144	BCV27	150	BF660	153	BFS18	153	BSR19A	160	BYV40	181
BC807-25	144	BCV61	140	BF720	160	BFS19	153	BSR20	160	BZD27	187
BC807-40	144	BCV62	144	BF721	160	BFS20	153	BSR20A	160	BZV55	186
BC808-16	144	BCV71	140	BF722	160	BFT25	155	BSR30	147	BZV80	188

Type Index (continued)

Type	Page	Type	Page	Type	Page	Type	Page	Type	Page	Type	Page
BZV81	183	PMBFJ109	163	PMBT50140	158	PMBZ5227B	189	PMBZ5252B	189	PXTA42	160
BZV90 series	190	PMBFJ163	163	PMBT5089	158	PMBZ5228B	189	PMBZ5253B	189	PXTA64	150
BZX84 series	188	PMBFJ164	163	PMBT5401	160	PMBZ5229B	189	PMBZ5254B	189	PXTA92	160
KTY85-163	168	PMBFJ112	163	PMBT5550	160	PMBZ5230B	189	PMBZ5255B	189	PZFJ108	163
KTY85-120	168	PMBFJ113	163	PMBT5551	160	PMBZ5231B	189	PMBZ5256B	189	PZFJ109	163
KTY85-150	168	PMBFJ174	163	PMBT6427	150	PMBZ5232B	189	PMBZ5257B	189	PZFJ163	163
PBYR235CT	179	PMBFJ175	163	PMBT6428	158	PMBZ5233B	189	PMLL4148	172	PZTA13	150
PBYR240CT	179	PMBFJ176	163	PMBT6429	158	PMBZ5234B	189	PMLL4150	172	PZTA14	150
PBYR245CT	179	PMBFJ177	163	PMBTA05	140	PMBZ5235B	189	PMLL4151	172	PZTA42	160
PMBD101	179	PMBFJ308	163	PMBTA06	140	PMBZ5236B	189	PMLL4153	172	PZTA43	160
PMBD352	179	PMBFJ309	163	PMBTA13	150	PMBZ5237B	189	PMLL4446	172	PZTA63	150
PMBD353	179	PMBFJ310	163	PMBTA14	150	PMBZ5238B	189	PMLL4448	172	PZTA64	150
PMBD1444	172	PMBT2222	140	PMBTA20	140	PMBZ5239B	189	PMLL5200 series	185	PZTA92	160
PMBD2835	172	PMBT2222A	140	PMBTA42	160	PMBZ5240B	189	PRLL4001	181	PZTA93	170
PMBD2836	172	PMBT2369	147	PMBTA43	160	PMBZ5241B	189	PRLL4002	181	PZT2222A	140
PMBD2837	172	PMBT2907	144	PMBTA55	144	PMBZ5242B	189	PRLL5817	179	PZT2907A	144
PMBD2838	172	PMBT2907A	144	PMBTA56	144	PMBZ5243B	189	PRLL5818	179	PZT3904	140
PMBD6050	172	PMBT3640	147	PMBTA63	150	PMBZ5244B	189	PRLL5819	179	PZT3906	144
PMBD6100	172	PMBT3903	140	PMBTA64	150	PMBZ5245B	189	PXT2222A	140	PZT4401	140
PMBD7000	172	PMBT3904	140	PMBTA70	144	PMBZ5246B	189	PXT2907A	144	PZT4403	144
PMBF43144	163	PMBT3906	144	PMBTA92	160	PMBZ5247B	189	PXT3904	140	2N7002	164
PMBF4392	163	PMBT4401	147	PMBTA93	160	PMBZ5248B	189	PXT3906	144		
PMBF4393	163	PMBT4403	144	PMBTH10	153	PMBZ5249B	189	PXT4401	140		
PMBF4416	163	PMBT5086	158	PMBTH81	153	PMBZ5250B	189	PXT4403	144		
PMBFJ108	163	PMBT5087	158	PMBZ5226B	189	PMBZ5251B	189	PXTA14	150		



General Purpose SMD® NPN Transistors

Description

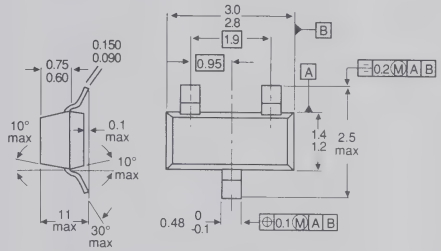
Philips Components general purpose transistors combine the highest quality standards with state-of-the-art production equipment to fulfill the need for generic, low-cost devices. These transistors provide a broad selection of current ratings, gains and saturation voltages to address a variety of circuit applications. They are offered in a choice of surface mount packages, providing the designer with alternatives for different power requirements, circuit board substrate materials, and assembly processing techniques.

Features

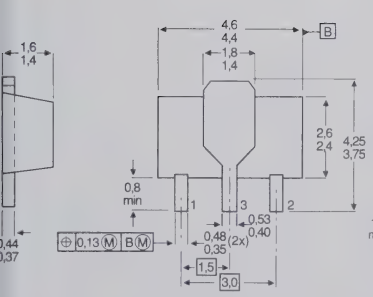
- Continuous current ratings up to 1A
- Complementary NPN and PNP devices
- SOT-89 for medium power applications
- SOT-223 for 1W power at 60°C on printed circuit boards

Mechanical Data

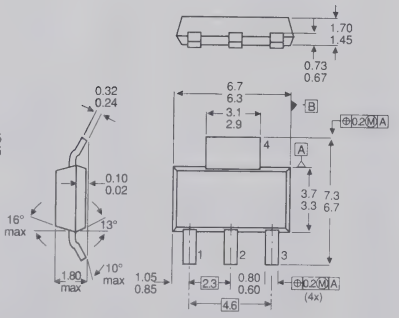
(Dimensions in mm)



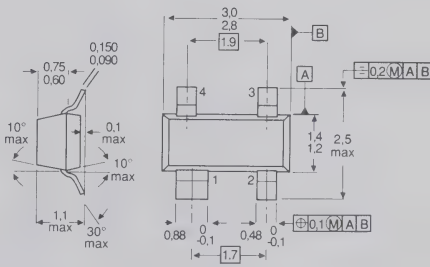
SOT-23 TOP VIEW



SOT-89 BOTTOM VIEW



SOT-223

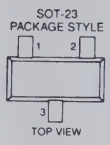


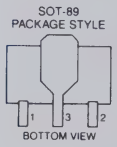
SOT-143 TOP VIEW

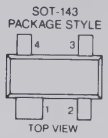
Electrical Specifications

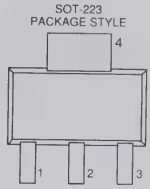
Type	Package	Ratings			h_{FE}		$V_{CE(sat)}$		f_T	Pinout
		V_{CEO} V	V_{CBO} V	I_C mA	min./max. at I_C/V_{CE} mA/V		max. at V	I_C/I_B mA/mA	typ MH_z	
NPN										
BC868	SOT-89	20	25	1000	85/375	500/1	0.50	1000/100	60	F
BCP68	SOT-223	20	25	1000	85/375	500/1	0.50	1000/100	60	R
BC818-16	SOT-23	25	25	500	100/250	100/1	0.62	500/50	100	F
BC818-25	SOT-23	25	25	500	160/400	100/1	0.62	500/50	100	F
BC818-40	SOT-23	25	25	500	250/600	100/1	0.62	500/50	100	F
BCX20	SOT-23	25	30	500	100/600	100/1	0.62	500/50	200	F
BC848A	SOT-23	30	30	200	110/220	2/5	0.25	10/0.5	300	F
BC848B	SOT-23	30	30	200	200/450	2/5	0.25	10/0.5	300	F
BC848C	SOT-23	30	30	200	420/800	2/5	0.25	10/0.5	300	F
BCV61	SOT-143	30	30	100	100/800	2/5	0.25	10/0.5	300	G
PMBT2222	SOT-23	30	60	600	100/300	150/10	0.4	150/15	> 250	F
BCW31	SOT-23	32	32	100	110/220	2/5	0.25	10/0.5	300	F
BCW32	SOT-23	32	32	100	220/450	2/5	0.25	10/0.5	300	F
BCW33	SOT-23	32	32	100	420/800	2/5	0.25	10/0.5	300	F
BCW60A	SOT-23	32	32	200	120/220	2/5	0.35	10/0.25	250	F
BCW60B	SOT-23	32	32	200	180/310	2/5	0.35	10/0.25	250	F
BCW60C	SOT-23	32	32	200	250/460	2/5	0.35	10/0.25	250	F
BCW60D	SOT-23	32	32	200	380/630	2/5	0.35	10/.25	250	F
PMBTA20	SOT-23	40	40	100	40/400	5/10	0.25	10/1	> 125	F
PMBT3903	SOT-23	40	60	200	50/150	10/1	0.20	10/1	> 250	F
PMBT3904	SOT-23	40	60	200	100/300	10/1	0.20	10/1	> 300	F
PXT3904	SOT-89	40	60	200	100/300	10/1	0.20	10/1	> 300	F
PZT3904	SOT-223	40	60	200	100/300	10/1	0.20	10/1	> 300	R
PZT4401	SOT-223	40	60	600	100/300	150/1	0.75	500/50	250	R
PXT4401	SOT-89	40	60	600	100/300	150/1	0.4	150/15	> 250	F
PMBT2222A	SOT-23	40	75	600	100/300	150/10	0.3	150/15	> 300	F
PXT2222A	SOT-89	40	75	600	100/300	150/10	0.3	150/15	> 300	F
PZT2222A	SOT-223	40	75	600	100/300	150/10	0.3	150/15	> 300	R
BC817-16	SOT-23	45	45	500	100/250	100/1	0.62	500/50	100	F
BC817-25	SOT-23	45	45	500	160/400	100/1	0.62	500/50	100	F
BC817-40	SOT-23	45	45	500	250/600	100/1	0.62	500/50	100	F
BCP54	SOT-223	45	45	1000	40/250	150/2	0.5	500/50	130	R
BCX54	SOT-89	45	45	1000	40/250	150/2	0.50	500/50	130	F
BCX70G	SOT-23	45	45	200	120/220	2/5	0.35	10/0.25	250	F
BCX70H	SOT-23	45	45	200	180/310	2/5	0.35	10/0.25	250	F
BCX70J	SOT-23	45	45	200	250/460	2/5	0.35	10/0.25	250	F
BCX70K	SOT-23	45	45	200	380/630	2/5	0.35	10/0.25	250	F
BC847A	SOT-23	45	50	200	110/220	2/5	0.25	10/0.5	300	F
BC847B	SOT-23	45	50	200	200/450	2/5	0.25	10/0.5	300	F
BC847C	SOT-23	45	50	200	420/800	2/5	0.25	10/0.5	300	F
BCW71	SOT-23	45	50	100	110/220	2/5	0.25	10/0.5	300	F
BCW72	SOT-23	45	50	100	200/450	2/5	0.25	10/0.5	300	F
BCW81	SOT-23	45	50	100	420/800	2/5	0.25	10/0.5	300	F
BCX19	SOT-23	45	50	500	100/600	100/1	0.62	500/50	200	F
BCP55	SOT-223	60	60	1000	40/250	150/2	0.5	500/50	130	R
BCX55	SOT-89	60	60	1000	40/250	150/2	0.50	500/50	130	F
PMBTA05	SOT-23	60	60	500	50/-	100/1	0.25	100/10	> 100	F
BCV71	SOT-23	60	80	100	110/220	2/5	0.25	10/0.5	300	F
BCV72	SOT-23	60	80	100	200/450	2/5	0.25	10/0.5	300	F
BC846A	SOT-23	65	80	200	110/220	2/5	0.25	10/0.5	300	F
BC846B	SOT-23	65	80	200	200/450	2/5	0.25	10/0.5	300	F
BCP56	SOT-223	80	100	1000	40/250	150/2	0.5	500/50	130	R
BCX56	SOT-89	80	100	1000	120/220	2/5	0.50	500/50	130	F
PMBTA06	SOT-23	80	80	100	50/-	100/1	0.25	100/10	> 100	F

Pinout Diagrams









	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT F: SOT-23	E	B	C	—
PINOUT F: SOT-89	E	B	C	—
PINOUT G: SOT-143	B,C_2	C_1	E_1	E_2
PINOUT R: SOT-223	B	C	E	C

Marking Codes

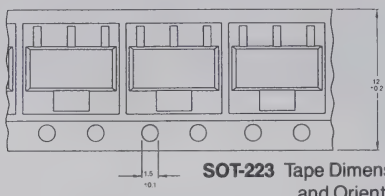
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BC817-16	6Ap	BC848C	1Lp	BCW60B	ABp	BCX70J	AJp
BC817-25	6Bp	BC868	CAC	BCW60C	ACp	BCX70K	AKp
BC817-40	6Cp	BCP54	*	BCW60D	ADp	PMBT2222	p1B
BC818-16	6Ep	BCP55	*	BCW71	K1p	PMBT2222A	p1P
BC818-25	6Fp	BCP56	*	BCW72	K2p	PMBT3903	p1Y
BC818-40	6Gp	BCP68	CAp	BCW81	K3p	PMBT3904	p1A
BC846A	1Ap	BCV61	IMp	BCX19	U1p	PMBTA05	p1H
BC846B	1Bp	BCV71	K7p	BCX20	U2p	PMBTA06	p1G
BC847A	1Ep	BCV72	K8p	BCX54	BAp	PMBTA20	p1C
BC847B	1Fp	BCW31	D1p	BCX55	BEp	PXT2222A	P1P
BC847C	1Gp	BCW32	D2p	BCX56	BHp	PXT3904	P1A
BC848A	1Jp	BCW33	D3p	BCX70G	AGp	PXT4401	P2X
BC848B	1Kp	BCW60A	AAp	BCX70H	AHp	PZT2222A	P1P
						PZT3904	1A
						PZT4401	*

*See individual device data sheet

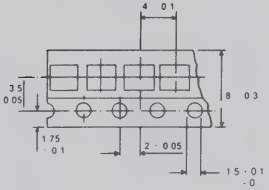
Tape and Reel Specifications

(Dimensions in mm)

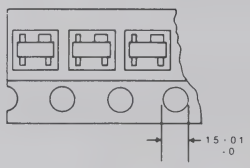
SM Package	Devices Per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



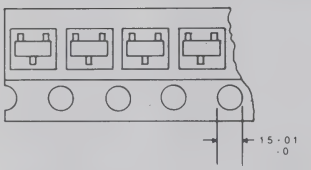
SOT-223 Tape Dimensions and Orientation



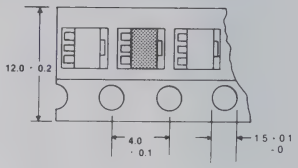
SOT-23 and SOT-143
Tape Dimensions



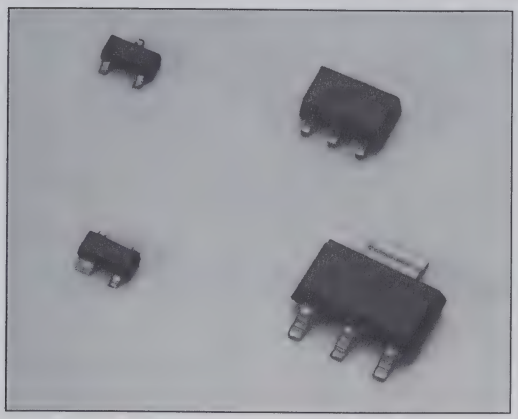
SOT-143
Orientation



SOT-23
Orientation



SOT-89
Tape Dimensions and Orientation



General Purpose SMD® PNP Transistors

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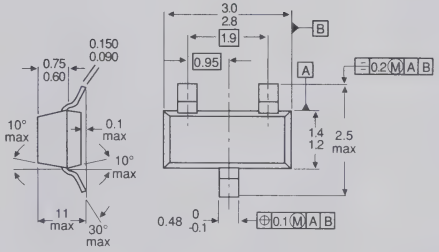
Features

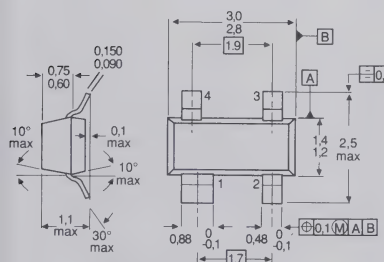
- Continuous current ratings up to 1A
- Complementary NPN and PNP devices
- SOT-89 for medium power applications
- SOT-223 for 1W power at 60°C on printed circuit boards

Mechanical Data

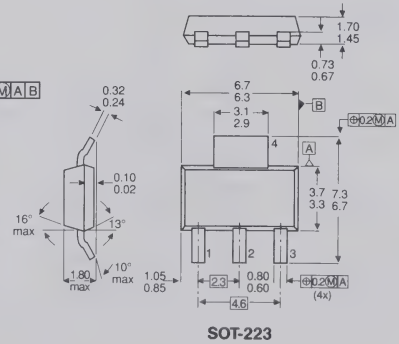
(Dimensions in mm)



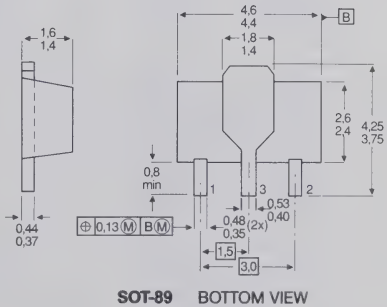
SOT-23 TOP VIEW



SOT-143 TOP VIEW



SOT-223

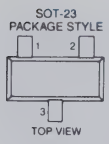


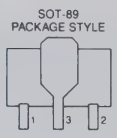
SOT-89 BOTTOM VIEW

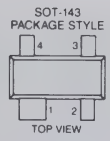
Electrical Specifications

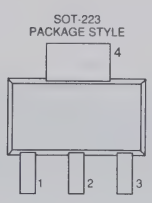
Type	Package	Ratings			h_{FE}		$V_{CE(sat)}$		f_T	Pinout
		V_{CEO} V	V_{CBO} V	I_C mA	min./max. at	I_C/V_{CE} mA/V	max. at v	I_C/I_B mA/mA	typ MH_z	
BC869	SOT-89	20	25	1000	85/375	500/1	0.50	100/100	60	F
BCP69	SOT-223	20	25	1000	85/375	500/1	0.50	1000/100	60	R
BCX18	SOT-23	25	—	500	100/600	100/1	0.62	500/50	100	F
BC808-16	SOT-23	25	30	500	100/250	100/1	0.70	500/50	100	F
BC808-25	SOT-23	25	30	500	160/400	100/1	0.7	500/500	100	F
BC808-40	SOT-23	25	30	500	250/600	100/1	0.7	500/500	100	F
BC858A	SOT-23	30	30	100	125/250	2/5	0.30	10/0.5	150	F
BC858B	SOT-23	30	30	100	220/475	2/5	0.3	10/0.5	150	F
BC858C	SOT-23	30	30	100	420/800	2/5	0.3	10/0.5	150	F
BCV62	SOT-143	30	30	100	100/800	2/5	0.30	10/0.5	150	G
BCW29	SOT-23	32	32	100	120/260	2/5	0.30	10/0.5	150	F
BCW30	SOT-23	32	32	100	215/500	2/5	0.30	10/0.5	150	F
BCW61A	SOT-23	32	32	200	120/200	2/5	0.25	10/0.5	180	F
BCW61B	SOT-23	32	32	200	180/310	2/5	0.25	10/0.5	180	F
BCW61C	SOT-23	32	32	200	250/460	2/5	0.25	10/0.5	180	F
BCW61D	SOT-23	32	32	200	380/630	2/5	0.25	10/0.5	180	F
PMBTA70	SOT-23	40	40	100	40/100	5/10	0.25	10/1	> 125	F
PMBT3906	SOT-23	40	40	200	100/300	10/1	0.25	10/1	> 250	F
PZT3906	SOT-223	40	40	200	100/300	10/1	0.25	10/1	> 250	R
PZT4403	SOT-223	40	40	600	100/300	150/2	0.75	500/50	200	R
PMBT4403	SOT-23	40	40	600	100/300	150/2	0.40	150/5	> 200	F
PXT3906	SOT-89	40	40	200	100/300	10/1	0.25	10/1	> 250	F
PXT4403	SOT-89	40	40	600	100/300	150/2	0.4	150/15	> 200	F
PMBT2907	SOT-23	40	60	600	100/300	150/10	0.4	150/15	> 200	F
BCP51	SOT-223	45	45	1000	40/250	150/2	0.50	500/50	50	R
BCX17	SOT-23	45	—	500	100/600	100/1	0.62	500/50	100	F
BCX51	SOT-89	45	45	1000	40/250	150/2	0.50	500/50	50	F
BCX71G	SOT-23	45	45	200	120/220	2/5	0.25	10/0.5	180	F
BCX71H	SOT-23	45	45	200	180/310	2/5	0.25	10/0.5	180	F
BCX71J	SOT-23	45	45	200	250/460	2/5	0.25	10/0.5	180	F
BCX71K	SOT-23	45	45	200	380/630	2/5	0.25	10/0.5	180	F
BC807-16	SOT-23	45	50	500	100/250	100/1	0.70	500/50	100	F
BC807-25	SOT-23	45	50	500	160/400	100/1	0.7	500/50	100	F
BC807-40	SOT-23	45	50	500	250/600	100/1	0.7	500/50	100	F
BC857A	SOT-23	45	50	100	125/250	2/5	0.30	10/0.5	150	F
BC857B	SOT-23	45	50	100	220/475	2/5	0.3	10/0.5	150	F
BC857C	SOT-23	45	50	100	420/800	2/5	0.3	10/0.5	150	F
BCW69	SOT-23	45	50	100	120/260	2/5	0.30	10/0.5	150	F
BCW70	SOT-23	45	50	100	215/500	2/5	0.30	10/0.5	150	F
BCP52	SOT-223	60	60	1000	40/250	150/2	0.50	500/50	50	R
BCX52	SOT-89	60	60	1000	40/250	150/2	0.50	500/50	50	F
PMBTA55	SOT-23	60	60	500	50/ –	100/1	0.25	100/10	> 50	F
PMBT2907A	SOT-23	60	60	600	100/300	150/10	0.4	150/15	> 200	F
PXT2907A	SOT-89	60	60	600	100/300	150/10	0.4	150/15	> 200	F
PZT2907A	SOT-223	60	60	600	100/300	150/10	0.4	150/15	> 200	R
BCW89	SOT-23	60	80	100	120/260	2/5	0.30	10/0.5	150	F
BC856A	SOT-23	65	80	100	220/475	2/5	0.3	10/0.5	150	F
BC856B	SOT-23	65	80	100	125/250	2/5	0.30	10/0.5	150	F
PMBTA56	SOT-23	80	80	500	50/ –	100/1	0.25	100/10	50	F
BCP53	SOT-223	80	100	1000	40/250	150/2	0.50	500/50	50	R
BCX53	SOT-89	80	100	1000	40/250	150/2	0.50	500/50	50	F

Pinout Diagrams









	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT F: SOT-23	E	B	C	—
PINOUT F: SOT-89	E	B	C	—
PINOUT G: SOT-143	B,C_2	C_1	E_1	E_2
PINOUT R: SOT-223	B	C	E	C

Marking Codes

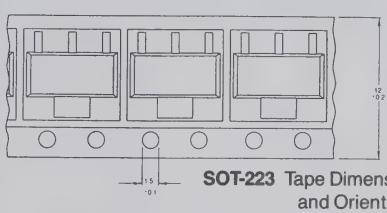
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BC807-16	5Ap	BC858C	3Lp	BCW69	H1p	PMBT2907A	p2F
BC807-25	5Bp	BC869	CEC	BCW70	H2p	PMBT3906	p2A
BC807-40	5Cp	BCP51	*	BCW89	H3p	PMBT4403	p2T
BC808-16	5Ep	BCP52	*	BCX17	T1p	PMBTA55	p2H
BC808-25	5Fp	BCP53	*	BCX18	T2p	PMBTA56	p2G
BC808-40	5Gp	BCP69	CEp	BCX51	AA	PMBTA70	p2C
BC856A	3Ap	BCV62	3Mp	BCX52	AE	PXT2907A	p2F
BC856B	3Bp	BCW29	C1p	BCX53	AH	PXT3906	p2A
BC857A	3Ep	BCW30	C2p	BCX71G	BGp	PXT4403	p2T
BC857B	3Fp	BCW61A	BAp	BCX71H	BHp	PZT2907A	p2F
BC857C	3Gp	BCW61B	BBp	BCX71J	BJp	PZT3906	2A
BC858A	3Jp	BCW61C	BCp	BCX71K	BKp	PZT4403	*
BC858B	3Kp	BCW61D	BDp	PMBT2907	p2B		

*See individual device data sheet

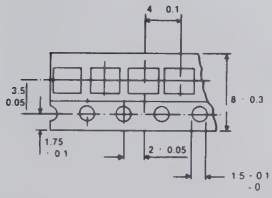
Tape and Reel Specifications

(Dimensions in mm)

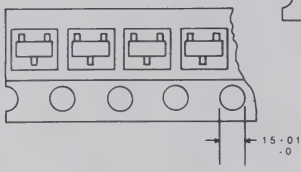
SM Package	Devices Per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



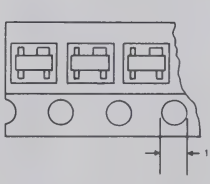
SOT-223 Tape Dimensions and Orientation



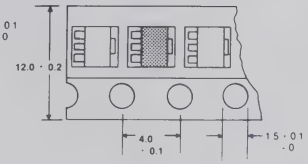
SOT-23 and SOT-143
Tape Dimensions



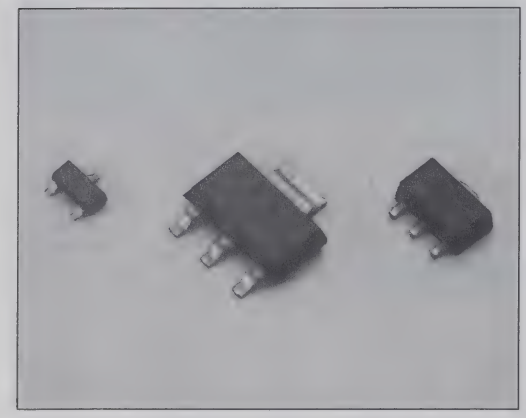
SOT-23
Orientation



SOT-143
Orientation



SOT-89
Tape Dimensions and Orientation



SMD® Switching Transistors

Description

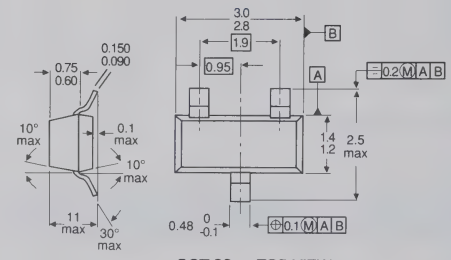
Philips Components switching transistors are fabricated using gold doping to reduce the minority carriers in the junction, thus improving the transition performance of the devices. All are specified for turn-off and turn-on times given resistive loaded circuits. These types are offered in a variety of surface mount transistor packages including the SOT-23, SOT-89 and the new SOT-223, which provide the designer options for addressing various power requirements, circuit board substrate materials, and assembly processing techniques.

Features

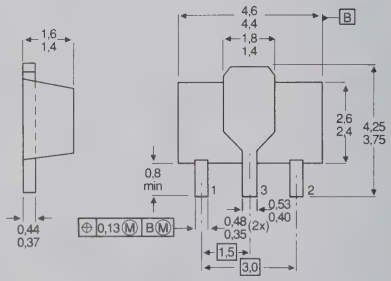
- Transition times under 12ns for high-speed saturated switching
- Complementary NPN and PNP pairs available
- Up to 1 Watt power dissipation rating @ 60°C on epoxy printed circuit boards with the new SOT-223 package
- Medium power devices offered in the SOT-89 package
- Continuous current ratings up to 1A available

Mechanical Data

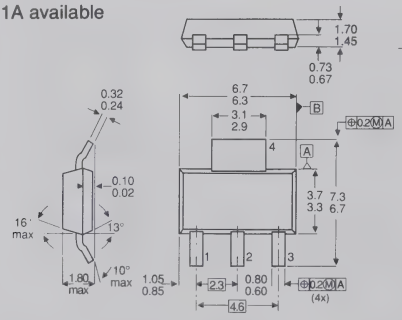
(Dimensions in mm)



SOT-23 TOP VIEW



SOT-89 BOTTOM VIEW

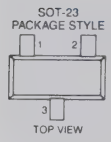


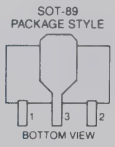
SOT-223

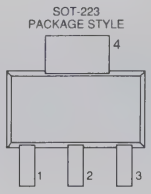
Electrical Specifications

Type	Package	Ratings			h_{FE}		$V_{CE(sat)}$		$t_{(max)}$		Pinout
		V_{CEO} V	V_{CBO} V	I_C mA	Min./Max. at I_C/V_{CE} mA/V		Max. at V	I_C/I_B mA/mA	On/Off at ns	I_C/I_B mA/mA	
NPN											
BSV52	SOT-23	12	20	100	40/120	10/1	0.4	50/15	12/18	10/3	F
PMBT2369	SOT-23	15	40	500	40/120	10/1	.25	10/1	12/18	10/3	F
BSR13	SOT-23	30	60	800	100/300	150/10	1.6	500/50	35/285	150/ –	F
PMBT2222	SOT-23	30	60	600	100/300	150/10	0.4	150/15	35/285	150/15	F
PXT4401	SOT-89	40	40	600	100/300	150/1	0.4	150/15	35/255	150/15	F
PMBT4401	SOT-23	40	50	600	100/300	150/1	0.4	150/15	35/255	150/15	F
BSR17	SOT-23	40	60	200	50/150	10/1	0.3	50/5	70/225	10/1	F
BSR17A	SOT-23	40	60	200	100/300	10/1	0.3	50/5	70/250	10/1	F
BSR14	SOT-23	40	75	800	100/300	150/10	1.6	500/50	35/285	150/1	F
PMBT2222A	SOT-23	40	75	600	100/300	150/10	0.3	150/15	35/285	150/15	F
PXT2222A	SOT-89	40	75	600	100/300	150/10	0.3	150/15	35/285	150/15	F
PZT2222A	SOT-223	40	75	600	100/300	150/10	0.3	150/15	35/285	150/15	R
BSP40	SOT-223	60	70	1000	40/120	100/5	0.5	500/50	250/1000	100/5	R
BSP41	SOT-223	60	70	1000	100/300	100/5	0.5	500/50	250/1000	100/5	R
BSR40	SOT-89	60	70	1000	40/120	100/5	0.5	500/50	250/1000	100/5	F
BSR41	SOT-89	60	70	1000	100/5	100/5	0.5	500/50	250/1000	100/5	F
BSP42	SOT-223	80	90	1000	40/120	100/5	0.5	500/50	250/1000	100/5	R
BSP43	SOT-223	80	90	1000	100/300	100/5	0.5	500/50	250/1000	100/5	R
BSR42	SOT-89	80	90	1000	40/120	100/5	0.5	500/50	250/1000	100/5	F
BSR43	SOT-89	80	90	1000	100/300	100/5	0.5	500/50	250/1000	100/5	F
BSS64	SOT-23	80	120	100	20/80	10/1	0.2	50/15	/1000	15/1	F
PNP											
PMBT3640	SOT-23	12	12	80	20/ –	50/1	0.6	50/5	25/35	10/5	F
BSR12	SOT-23	15	15	100	30/120	50/1	0.45	100/10	20/30	30/3	F
BSR18	SOT-23	40	40	200	50/150	10/1	0.40	50/5	70/250	10/1	F
BSR18A	SOT-23	40	40	200	100/300	10/1	0.4	50/5	70/300	10/1	F
PMBT4403	SOT-23	40	40	600	100/300	150/2	0.4	150/15	35/255	150/15	F
PXT4403	SOT-89	40	40	600	100/300	150/2	0.4	150/15	35/255	150/15	F
BSR15	SOT-23	40	60	600	100/300	150/10	1.6	500/50	45/100	150/15	F
PMBT2907	SOT-23	40	60	600	100/300	150/10	0.4	150/15	45/100	150/15	F
BSR16	SOT-23	60	60	600	100/300	150/10	1.6	500/50	45/100	150/15	F
PMBT2907A	SOT-23	60	60	600	100/300	150/10	0.4	150/15	45/100	150/15	F
PXT2907A	SOT-89	60	60	600	100/300	150/10	0.4	150/15	45/100	150/15	F
PZT2907A	SOT-223	60	60	600	100/300	150/10	0.4	150/15	45/100	150/15	R
BSP30	SOT-223	60	70	1000	40/120	100/5	0.5	500/50	500/650	100/5	R
BSP31	SOT-223	60	70	1000	100/300	100/5	0.5	500/50	500/650	100/5	R
BSR30	SOT-89	60	70	1000	40/120	100/5	0.5	500/50	500/650	100/5	F
BSR31	SOT-89	60	70	1000	100/300	100/5	0.5	500/50	500/650	100/5	F
BSP32	SOT-223	80	90	1000	40/120	100/5	0.5	500/50	500/650	100/5	R
BSP33	SOT-223	80	90	1000	100/300	100/5	0.5	500/50	500/650	100/5	R
BSR32	SOT-89	80	90	1000	40/120	100/5	0.5	500/50	500/650	100/5	F
BSR33	SOT-89	80	90	1000	100/300	100/5	0.5	500/50	500/650	100/5	F
BSS63	SOT-23	100	110	100	30/ –	25/1	0.25	25/2.5	—	—	F

Pinout Diagrams







PINOUT F: SOT-23
PINOUT F: SOT-89
PINOUT R: SOT-223

PIN 1	PIN 2	PIN 3	PIN 4
E	B	C	—
E	B	C	—
B	C	E	C

Marking Codes

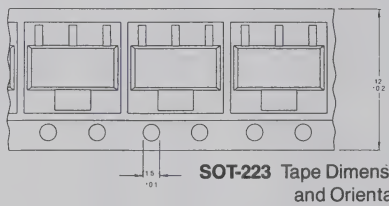
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BSP30	BR1	BSR15	T7p	BSR41	AR2	PMBT3640	V25
BSP31	BR2	BSR16	T8p	BSR42	AR3	PMBT4401	p2X
BSP32	BR3	BSR17	U9p	BSR43	AR4	PMBT4403	p2T
BSP33	BR4	BSR17A	U92	BSS63	BMp	PXT2222A	p1P
BSP40	AR1	BSR18	T9p	BSS64	AMp	PXT2907A	p2F
BSP41	AR2	BSR18A	T92	BSV52	B2p	PXT4401	p2X
BSP42	AR3	BSR30	BR1	PMBT2222	p1B	PXT4403	p2T
BSP43	AR4	BSR31	BR2	PMBT2222A	p1P	PZT2222A	p1P
BSR12	B5p	BSR32	BR3	PMBT2369	p1J	PZT2907A	p2F
BSR13	U7p	BSR33	BR4	PMBT2907	p2B		
BSR14	U8p	BSR40	AR1	PMBT2907A	p2F		

*See individual device data sheet.

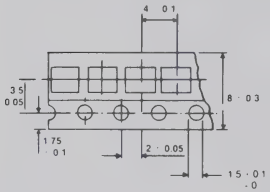
Tape and Reel Specifications

(Dimensions in mm)

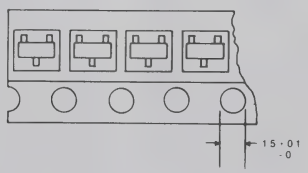
SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



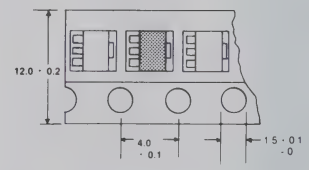
SOT-223 Tape Dimensions and Orientation



SOT-23
Tape Dimensions



SOT-23
Orientation



SOT-89
Tape Dimensions and Orientation

SMD® Darlington Transistors

Description

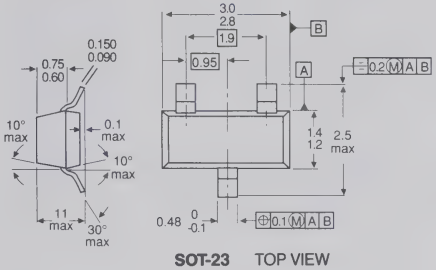
Philips Components Darlington transistors provide high input impedance and thus high gain by virtue of two series-integrated transistors on a single chip. High current versions are excellent for industrial switching applications such as driving print hammers, solenoids, relays and lamps. Lower current types are ideal for preamplifier input applications. Darlington transistors are offered in a choice of surface mount packages to address various power requirements, substrates and soldering options available to the designer.

Features

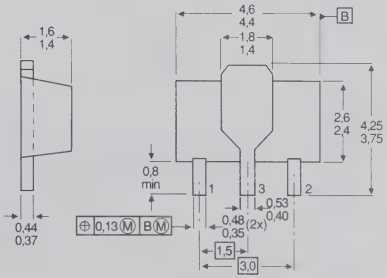
- Gains up to 20,000
- High current types handle up to 90V breakdown and 1.5A surge
- Complementary NPN and PNP devices
- SOT-89 for medium power applications
- SOT-223 for 1W power at 60°C on printed circuit boards

Mechanical Data

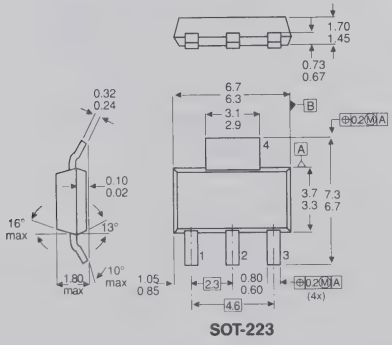
(Dimensions in mm)



SOT-23 TOP VIEW



SOT-89 BOTTOM VIEW

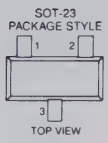


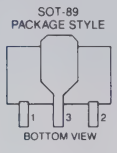
SOT-223

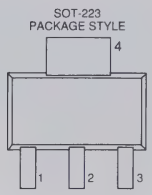
Electrical Specifications

Type	Package	Ratings			h_{FE}		$V_{CE(sat)}$		f_T	Pinout
		V_{CEO} V	V_{CBO} V	I_C mA	Min./Max. at I_C/V_{CE} mA/A		Max. at I_C/I_B V	mA/mA	Typ. MH_z	
NPN										
PMBTA13	SOT-23	20	30	300	10,000	100/5	1.5	100/0.1	125	F
PZTA13	SOT-223	20	30	300	10,000	100/5	1.5	100/0.1	125	R
PMBTA14	SOT-23	30	30	300	20,000	100/5	1.5	100/0.1	125	F
PXTA14	SOT-89	30	30	300	20,000	100/5	1.5	100/0.1	125	F
PZTA14	SOT-223	30	30	300	20,000	100/5	1.5	100/0.1	125	R
BCV27	SOT-23	30	40	300	20,000	100/5	1.0	100/0.1	100	F
PMBT6427	SOT-23	40	40	500	14,000	500/5	1.5	500/0.5	—	F
BSP50	SOT-223	60	45	500	2,000	500/10	1.3	500/0.5	—	R
BST50	SOT-89	60	45	500	2,000	500/10	1.3	500/0.5	—	F
BST51	SOT-89	80	60	500	2,000	500/1	1.3	500/0.5	—	F
BSP52	SOT-223	90	80	500	2,000	500/5	1.3	500/0.5	—	R
BST52	SOT-89	90	80	500	2,000	500/5	1.3	500/0.5	—	F
PNP										
PMBTA63	SOT-23	30	30	300	10,000	100/5	1.5	100/0.1	125	F
PMBTA64	SOT-23	30	30	300	20,000	100/5	1.5	100/0.1	125	F
PXTA64	SOT-89	30	30	300	20,000	100/5	1.5	100/0.1	125	F
PZTA63	SOT-223	30	30	300	10,000	100/5	1.5	100/0.1	125	R
PZTA64	SOT-223	30	30	300	20,000	100/5	1.5	100/0.1	125	R
BCV26	SOT-23	30	40	300	20,000	100/5	1.0	100/0.1	100	F
BSP60	SOT-223	60	45	500	2,000	500/10	1.3	500/0.5	—	R
BST60	SOT-89	60	45	500	2,000	500/10	1.3	500/0.5	—	F
BSP61	SOT-223	80	60	500	2,000	500/10	1.3	500/0.5	—	R
BST61	SOT-89	80	60	500	2,000	500/10	1.3	500/0.5	—	F
BSP62	SOT-223	90	80	500	2,000	500/10	1.3	500/0.5	—	R
BST62	SOT-89	90	80	500	2,000	500/10	1.3	500/0.5	—	F

Pinout Diagrams







PINOUT F: SOT-23
PINOUT F: SOT-89
PINOUT G: SOT-143
PINOUT R: SOT-223

PIN 1	PIN 2	PIN 3	PIN 4
E	B	C	—
E	B	C	—
B_1C_2	C_1	E_1	E_2
B	C	E	C

Marking Codes

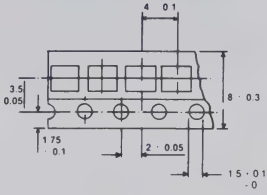
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BCV26	FDp	BSP62	BS3	BST62	BS3	PXTA14	p1N
BCV27	FFp	BST50	AS1	PMBT6427	p1V	PXTA64	p2V
BSP50	AS1	BST51	AS2	PMBTA13	p1M	PZTA13	p1M
BSP52	AS3	BST52	AS3	PMBTA14	p1N	PZTA14	p1N
BSP60	BS1	BST60	BS1	PMBTA63	p2U	PZTA63	p2U
BSP61	BS2	BST61	BS2	PMBTA64	p2V	PZTA64	p2V

*See individual device data sheet

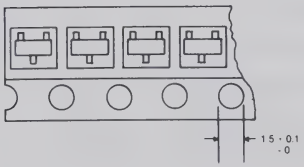
Tape and Reel Specifications

(Dimensions in mm)

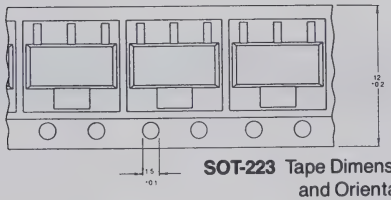
SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



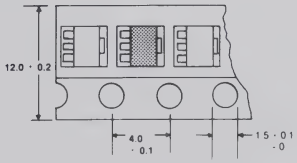
SOT-23
Tape Dimensions



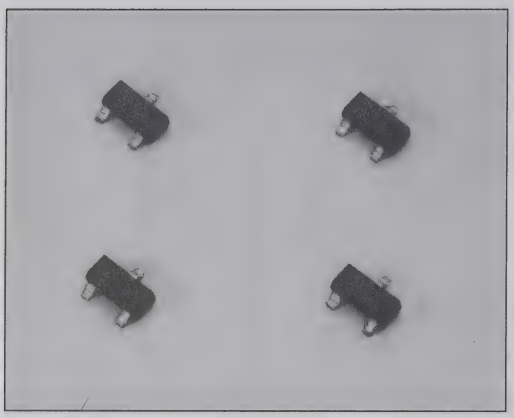
SOT-23
Orientation



SOT-223 Tape Dimensions and Orientation



SOT-89
Tape Dimensions and Orientation



High Frequency SMD® Transistors

Description

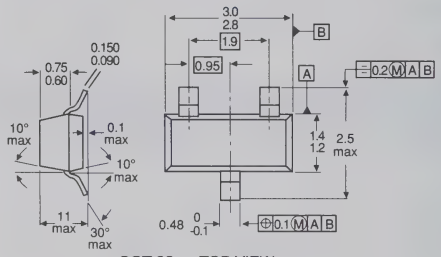
Philips Components high-frequency transistors fill the gap between general purpose transistors and wideband transistors by offering transition frequencies from a few hundred megahertz to about 1 gigahertz. Applications include IF preamplifiers, oscillators for VHF/UHF tuners, and RF stages for FM front ends.

Features

- Typical feedback capacitances as low as 0.1 pF
- Transition frequencies up to 1.3 GHz
- Typical noise figures from 2-4.5 dB
- Complementary NPN and PNP devices

Mechanical Data

(Dimensions in mm)



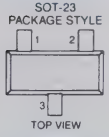
SOT-23 TOP VIEW

Philips Semiconductors 100 Providence Pike, Slatersville, RI 02876-2078 (401) 762-3800

Electrical Specifications

Type	Package	Ratings			h_{FE}		NF		f_T	C_{re}	Pinout
		V_{CEO} V	V_{CBO} V	I_C mA	Min./Max. at I_C/V_{CE} mA/V		Typ. at I_C dB	mA	Typ. MH_z	Typ. pF	
NPN											
BFS18	SOT-23	20	30	30	35/125	1/10	4	1	200	0.85	F
BFS19	SOT-23	20	30	30	65/225	1/10	4	1	260	0.85	F
BFS20	SOT-23	20	30	25	40/–	7/10	—	—	450	0.35	F
BF747	SOT-23	20	30	50	40/250	2/10	—	—	1200	—	F
BF840	SOT-23	40	40	25	—	—	1.5	1	380	0.3	F
BF841	SOT-23	40	40	25	—	—	2.0	1	380	0.3	F
PMBTH10	SOT-23	25	30	—	60/—	4/10	—	—	>0.65	0.3	F
PMBTH81	SOT-23	20	20	—	60/—	5/10	—	—	>0.6	—	F
PNP											
BF579	SOT-23	20	20	25	20/–	10/10	4.5	10	1350	0.46	F
BF536	SOT-23	30	30	25	25/–	1/10	5	1	350	—	F
BF767	SOT-23	30	30	20	15/–	3/10	4	3	900	0.3	F
BF824	SOT-23	30	30	25	—	—	3	2	440	0.1	F
BF660	SOT-23	30	40	25	30/–	3/10	—	—	650	0.65	F
BF569N	SOT-23	35	40	30	25/–	3/10	4.5	3	900	0.33	F
BF550	SOT-23	40	40	35	50/–	1/10	2	1	325	0.5	F

Pinout Diagram



PINOUT F: SOT-23

PIN 1	PIN 2	PIN 3
E	B	C

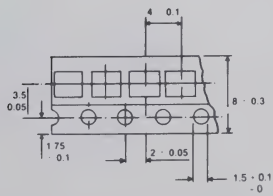
Marking Codes

Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BF536	G3p	BF660	LEp	BF824	F8p	BFS18	F1p
BF550	LAp	BF747	E15	BF840	NCp	BFS19	F2p
BF569	LHp	BF767	G9p	BF841	NDp	BFS20	G1p
BF579	LJp						

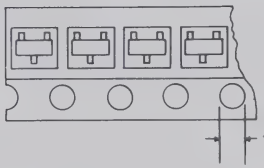
Tape and Reel Specifications

(Dimensions in mm)

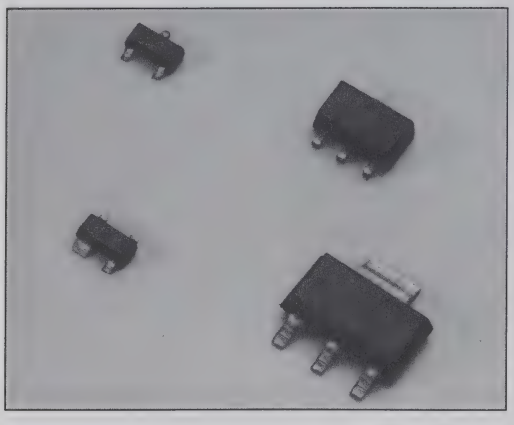
SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13



SOT-23
Tape Dimensions



SOT-23
Orientation



Wideband SMD® Transistors

Description

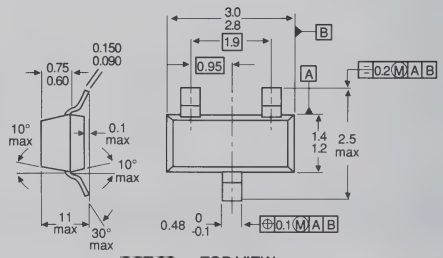
Philips Components wideband transistors are the result of leading-edge technology dedicated to expanding performance and selection in the wideband arena. The devices are ideal amplifiers for VHF, UHF, and microwave frequencies up to 1 GHz. Typical applications are in satellite and cable television and fiber optic repeaters.

Features

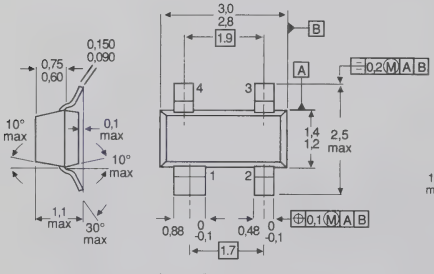
- Typical transition frequencies up to 12 GHz
- Excellent output voltage capabililities—power gains of 16 dB
- Typical noise figures as low as 2.5 dB
- Collector current ratings as high as 150 mA D.C.
- Complementary NPN and PNP devices
- SOT-223 for 1 W power at 60°C on printed circuit boards

Mechanical Data

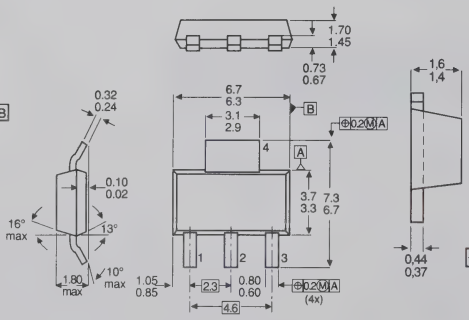
(Dimensions in mm)



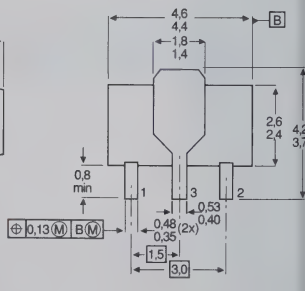
SOT-23 TOP VIEW



SOT-143 TOP VIEW



SOT-223



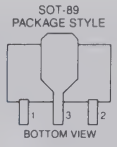
SOT-89 BOTTOM VIEW

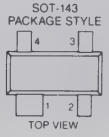
Electrical Specifications

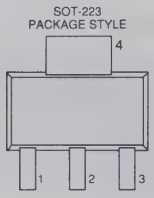
Type	Package	Ratings			h_{FE}		NF		f_T	C_{re}	Pinout
		V_{CEO} V	V_{CBO} V	I_C mA	Min./Max. at I_C/V_{CE} mA/V		Typ. at I_C dB	mA	Typ. GH_z	Typ. pF	
NPN											
BFT25	SOT-23	5	8	6.5	20/ –	1/1	3.8	1	2.3	0.45	F
BFR53	SOT-23	10	18	50	25/ –	50/5	5.0	2	2.0	0.9	F
BFG67(X)*	SOT-143	10	20	50	60/ –	15/5	2.5	5	7.5	0.5	Q
BFG97	SOT-223	10	20	100	25/90	70/10	—	—	5.5	1.0	S
BFQ67	SOT-23	10	20	50	100typ	15/5	2.5	5	7.5	0.5	F
BFR93	SOT-23	12	15	35	25/ –	30/5	1.9	2	5.0	0.8	F
BFR93A	SOT-23	12	15	35	40/ –	3-/5	1.6	4	5.0	0.6	F
BFQ19	SOT-89	15	20	75	25/ –	75/10	3.3	50	5.0	1.3	F
BFR92	SOT-23	15	20	25	25/ –	14/10	2.4	2	5.0	0.7	F
BFR92A	SOT-23	15	20	25	40/ –	14/10	1.8	4	5.0	0.35	F
BFQ18A	SOT-89	15	20	150	25/ –	100/10	—	—	3.6	1.2	F
BFS17	SOT-23	15	25	25	20/150	2/1	4.5	2	1.3	0.65	F
BFS17A	SOT-23	15	25	35	20/ –	2/1	2.5	2	2.8	0.6	F
BFG17A	SOT-143	15	25	25	20/150	2/1	2.5	2	2.8	0.6	Q
BFG25AX	SOT-143	5	8	6.5	50/200	0.5/1	1.8	1	5	0.22	X
BFG35	SOT-223	18	25	150	25/140	100/10	—	—	4.0	1.2	S
BFG94	SOT-223	12	15	60	45/ –	30/5	3	45	1.8	0.5	S
BFQ17	SOT-89	25	40	150	25/ –	150/5	—	—	1.2	1.9	F
BFG16A*	SOT-223	25	40	300	25/ –	150/5	6 Max	30	1.2	1.7	S
BFG33(X)*	SOT-143	7	9	20	25/ –	14/5	2.5	5	12	—	Q
BFG92A(X)*	SOT-143	15	20	25	40/ –	14/10	—	—	5	0.35	Q
BFG93A(X)*	SOT-143	12	15	35	40/ –	30/5	—	—	6	0.6	Q
BFG135	SOT-223	15	25	150	80/ –	100/10	—	—	7	1.2	S
BFG197(X)*	SOT-143	10	20	100	40/ –	50/5	—	—	7.5	0.85	Q
BFG198	SOT-223	10	20	100	40/ –	50/5	—	—	8	0.8	S
BFR106	SOT-23	15	20	100	25/ –	20/8	—	—	3.3	1.2	
PNP											
BFT93	SOT-23	12	15	35	20/ –	30/5	2.4	2	5	1.0	F
BFT92	SOT-23	15	20	25	20/ –	14/10	2.7	2	5	0.7	F
BFQ149	SOT-89	15	20	75	20/ –	50/10	3.75	50	4.4	0.35	F
BFG31	SOT-223	15	20	100	25/ –	70/10	—	—	5	1.6	S
BFG55	SOT-223	18	25	150	25 typ	100/10	—	—	4	1.7	S

*"X" version has Pinout X.

Pinout Diagrams







	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT F: SOT-23	E	B	C	—
PINOUT F: SOT-89	E	B	C	—
PINOUT Q: SOT-143	C	B	E	E
PINOUT S: SOT-223	E	B	E	C
PINOUT X: SOT-143	C	E	B	E

Marking Codes

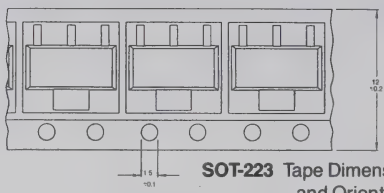
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BFG16A	*	BFG93A	*	BFQ67	V2p	BFS17	E1p
		BFG94	*				
BFG17A	E6	BFG97	*	BFQ149	*	BFS17A	E2p
BFG25AX	*						
BFG31	*	BFG135	*	BFR53	N1p	BFT25	V1p
BFG33	V6	BFG197	*	BFR92	P1p	BFT92	W1p
BFG35	*	BFG198	*	BFR92A	P2p	BFT93	X1p
BFG55	*	BFQ17	FAp	BFR93	R1p		
BFG67	V3p	BFQ18A	FFp	BFR93A	R2p		
BFG92A	*	BFQ19	FBp	BFR106	R7p		

*See individual device data sheet

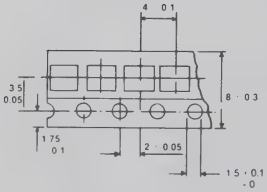
Tape and Reel Specifications

(Dimensions in mm)

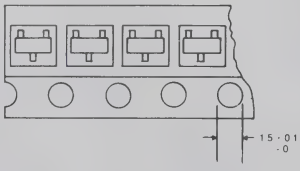
SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



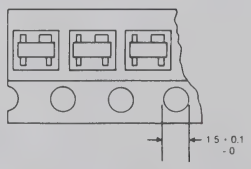
SOT-223 Tape Dimensions and Orientation



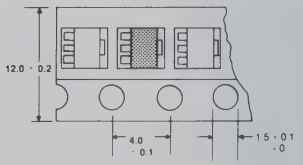
SOT-23 and SOT-143
Tape Dimensions



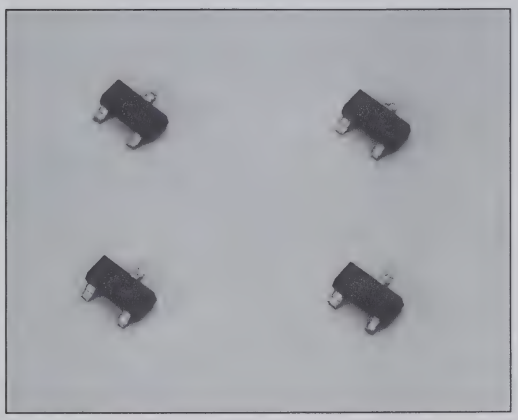
SOT-23
Orientation



SOT-143
Orientation



SOT-89
Tape Dimensions and Orientation



Low Noise SMD® Transistors

Description

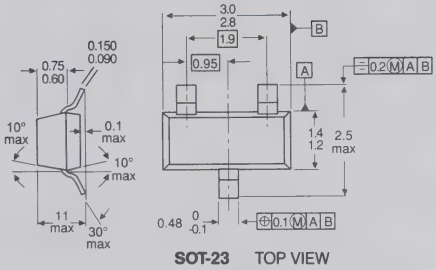
Philips Components low-noise transistors are optimized for operation on low level signals as required by audio and other amplifier circuits. All have guaranteed low-current specifications for noise, gain and saturation voltages.

Features

- Typical noise figures as low as 1 dB at 200 μA
- DC gain specified at test limits as low as 10 μA
- Complementary NPN and PNP devices
- Compatible with wave or reflow soldering

Mechanical Data

(Dimensions in mm)

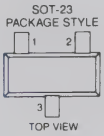


SOT-23 TOP VIEW

Electrical Specifications

Type	Package	Ratings			NF		h_{FE}		$V_{CE(sat)}$		f_T	Pinout
		V_{CEO} V	V_{CBO} V	I_C mA	Typ. at I_C dB	μA	Min./Max. at I_C/V_{CE}	mA/V	Max. at I_C/I_B V	mA/mA	Typ. MH_z	
NPN												
PMBT5089	SOT-23	25	30	50	1.2	100	400/–	10/5	0.5	10/1	100	F
BC849B	SOT-23	30	30	200	1.2	200	200/450	2/5	0.25	10/0.5	300	F
BC849C	SOT-23	30	30	200	1.2	200	420/800	2/5	0.25	10/0.5	300	F
PMBT5088	SOT-23	30	35	50	1.0	100	300/–	10/5	0.5	10/1	100	F
BCF32	SOT-23	32	32	100	1.2	200	200/450	2/5	0.25	10/0.5	300	F
BCF33	SOT-23	32	32	100	1.2	200	420/800	2/5	0.25	10/0.5	300	F
BC850B	SOT-23	45	50	200	1.0	200	200/450	2/5	0.25	10/0.5	300	F
BC850C	SOT-23	45	50	200	1.0	200	420/800	2/5	0.25	10/0.5	300	F
BCF81	SOT-23	45	50	100	1.2	200	420/800	2/5	0.25	10/0.5	300	F
PMBT6429	SOT-23	45	55	200	0.5	100	500/–	10/5	0.2	10/0.5	100	F
PMBT6428	SOT-23	50	60	200	0.5	100	250/–	10/5	0.2	10/0.5	100	F
PNP												
BC859A	SOT-23	30	30	100	1.2	200	125/250	2/5	0.3	10/0.5	150	F
BC859B	SOT-23	30	30	100	1.2	200	220/475	2/5	1.0	10/0.5	150	F
BC859C	SOT-23	30	30	100	1.2	200	420/800	2/5	0.3	10/0.5	150	F
BCF29	SOT-23	32	32	100	1.0	200	120/260	2/5	0.3	10/0.5	150	F
BCF30	SOT-23	32	32	100	1.0	200	215/500	2/5	0.3	10/0.5	150	F
BC860A	SOT-23	45	50	100	1.0	200	125/250	2/5	0.3	10/0.5	150	F
BC860B	SOT-23	45	50	100	1.0	200	220/475	2/5	0.3	10/0.5	150	F
BC860C	SOT-23	45	50	100	1.0	200	420/800	2/5	0.3	10/0.5	150	F
BCF70	SOT-23	45	50	100	1.0	200	215/500	2/5	0.3	10/0.5	150	F
PMBT5086	SOT-23	50	50	50	1.2	100	150/–	10/5	0.3	10/1	100	F
PMBT5087	SOT-23	50	50	50	1.0	100	250/–	10/5	0.3	10/1	100	F

Pinout Diagram



PINOUT F: SOT-23

PIN 1	PIN 2	PIN 3
E	B	C

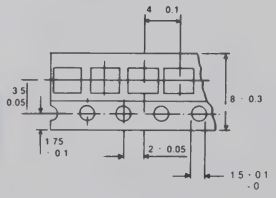
Marking Codes

Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BC849B	2Bp	BC859C	4Cp	BCF32	D7p	PMBT5088	p1Q
BC849C	2Cp	BC860A	4Ep	BCF33	D8p	PMBT5089	p1R
BC850B	2Fp	BC860B	4Fp	BCF70	H7p	PMBT6428	p1K
BC850C	2Gp	BC860C	4Gp	BCF81	K9p	PMBT6429	p1L
BC859A	4Ap	BCF29	C7p	PMBT5086	2p		
BC859B	4Bp	BCF30	C8p	PMBT5087	2Q		

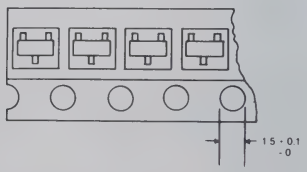
Tape and Reel Specifications

(Dimensions in mm)

SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13



SOT-23
Tape Dimensions



SOT-23
Orientation

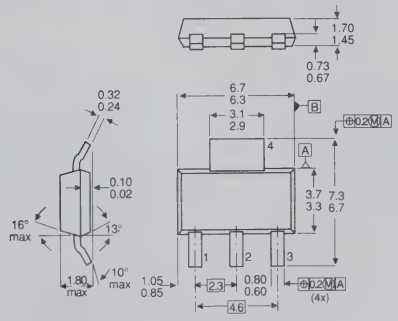
High Voltage SMD® Transistors

Description

Philips Components produces a variety of chip geometries in order to offer high voltage transistors with a broad range of current handling capabilities. The result is a device which not only fulfills high voltage application needs, but precisely matches current requirements without wasting silicon and increasing costs. High voltage transistors are offered in a choice of surface mount packages, allowing matching of power dissipation to circuit, substrate and soldering requirements.

Features

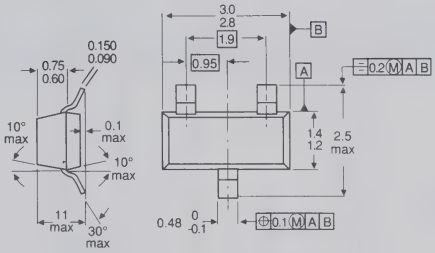
- Reverse breakdown voltages up to 400V
- Continuous current ratings from 20 mA to 1A
- Complementary NPN and PNP devices
- SOT-89 for medium power applications
- SOT-223 for 1W power at 60°C on printed circuit boards



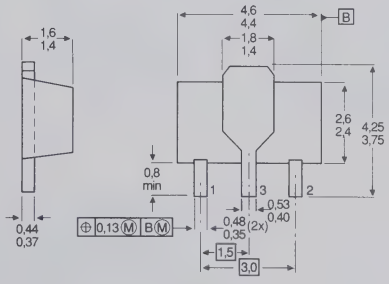
SOT-223

Mechanical Data

(Dimensions in mm)



SOT-23 TOP VIEW

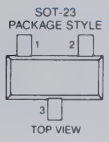


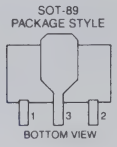
SOT-89 BOTTOM VIEW

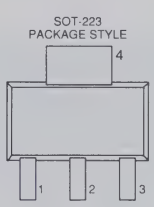
Electrical Specifications

Type	Package	Ratings			h_{FE}		$V_{CE(sat)}$		f_T	Pinout
		V_{CEO} V	V_{CBO} V	I_C mA	Min./Max. at I_C/V_{CE} mA/V		Max. at I_C/I_B V	mA/mA	Typ. MH_z	
NPN										
BF620	SOT-89	—	300	20	50/–	25/20	0.6	30/5	60	F
BF720	SOT-223	—	300	50	50/–	25/20	0.6	30/5	60	R
BF820	SOT-23	—	300	50	50/–	25/20	0.6	30/5	60	F
BSR19	SOT-23	140	160	600	60/250	10/5	0.25	50/5	100	F
PMBT5550	SOT-23	140	160	600	60/250	10/5	0.15	10/1	200	F
BSR19A	SOT-23	160	180	600	80/250	10/5	0.2	50/5	100	F
PMBT5551	SOT-23	160	180	600	80/250	10/5	0.15	10/1	200	F
PMBTA43	SOT-23	200	200	500	40/–	30/10	0.5	20/2	50	F
PZTA43	SOT-223	200	200	500	40/–	30/10	0.5	20/2	50	R
BF622	SOT-89	250	250	20	50/–	25/20	0.6	30/5	60	F
BF722	SOT-223	250	250	50	50/–	25/20	0.6	30/5	60	R
BF822	SOT-23	250	250	50	50/–	25/20	0.6	30/5	60	F
BSP20	SOT-223	250	300	1000	40/160	30/10	0.5	20/2	50	R
BST40	SOT-89	250	300	1000	40/160	20/10	0.50	50/4	15	F
PMBTA42	SOT-23	300	300	500	40/–	30/10	0.5	20/2	50	F
PZTA42	SOT-223	300	300	500	40/–	30/10	0.5	20/2	50	R
BSP19	SOT-223	350	400	1000	40/160	20/10	0.50	50/4	15	R
BST39	SOT-89	350	400	1000	40/160	20/10	0.50	50/4	15	F
PXTA42	SOT-89	300	300	500	40/1	30/10	0.50	20/2	50	F
PNP										
BF621	SOT-89	—	300	20	50/–	25/20	0.8	30/5	60	F
BF721	SOT-223	—	300	50	50/–	25/20	0.8	30/5	60	R
BF821	SOT-23	—	300	50	50/–	25/20	0.8	30/5	60	F
BF823	SOT-23	50	250	50	50/–	25/20	0.8	30/5	60	F
BSR20	SOT-23	120	130	600	40/180	10/5	0.5	50/5	100	F
BSR20A	SOT-23	150	160	600	60/240	10/5	0.5	50/5	100	F
PMBT5401	SOT-23	150	160	600	60/240	10/5	0.2	10/1	200	F
BF723	SOT-223	200	200	50	50/–	25/20	0.8	30/5	60	R
BSP15	SOT-223	200	200	1000	30/150	50/10	2.5	50/5	15	R
BST15	SOT-89	200	200	1000	30/150	50/10	2.5	50/5	15	F
PMBTA93	SOT-23	200	200	500	25/–	30/10	0.5	20/2	50	F
BF623	SOT-89	200	200	20	25/–	30/10	0.5	20/2	50	F
PZTA93	SOT-223	200	200	500	25/–	30/10	0.5	20/2	50	R
BSP16	SOT-223	300	350	1000	30/120	50/10	2.5	50/5	15	R
BST16	SOT-89	300	350	1000	30/120	50/10	2.0	50/5	15	F
PMBTA92	SOT-23	300	300	500	25/–	30/10	0.5	20/2	50	F
PXTA92	SOT-89	300	300	500	25/–	30/10	0.5	20/2	50	F
PZTA92	SOT-223	300	300	500	25/–	30/10	0.5	20/2	50	R

Pinout Diagrams







	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT F: SOT-23	E	B	C	—
PINOUT F: SOT-89	E	B	C	—
PINOUT R: SOT-223	B	C	E	C

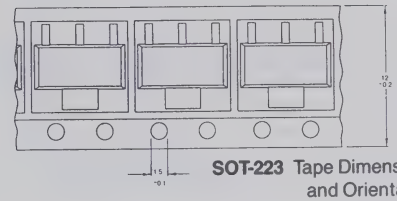
Marking Codes

Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BF620	DCp	BF821	1Wp	BSR20	T35	PMBTA42	p1D
BF621	DFp	BF822	1Xp	BSR20A	T36	PMBTA43	p1E
BF622	DAp	BF823	1Yp	BST15	BT1	PMBTA92	p2D
BF623	DBp	BSP15	BT1	BST16	BT2	PMBTA93	p2E
BF720	DCp	BSP16	BT2	BST39	AT1	PXTA42	*
BF721	DFp	BSP19	AT1	BST40	AT2	PXTA92	*
BF722	DAp	BSP20	AT2	PMBT5401	p2L	PZTA42	p1D
BF723	DBp	BSR19	U35	PMBT5550	pIF	PZTA43	p1E
BF820	IVp	BSR19A	U36	PMBT5551	pG1	PZTA92	p2D
						PZTA93	p2E

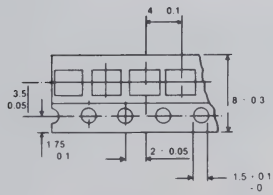
Tape and Reel Specifications

(Dimensions in mm)

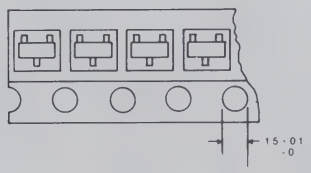
SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



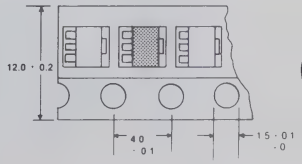
SOT-223 Tape Dimensions and Orientation



SOT-23
Tape Dimensions



SOT-23
Orientation



SOT-89
Tape Dimensions and Orientation

SMD® FET's

Description

Philips Components surface mount range of FET's is the most extensive available, and offers low parasitic capacitance, negligible inductance, and reduced board assembly cost. The three categories of FET's each have its own attributes and applications:

Junction FET's (JFET's): Rugged and economical, able to withstand large transient voltages. Extremely high input impedance, low power consumption, and high dynamic range allow for application in all types of low voltage switching and amplification.

N-Channel MOSFET's: Available in both single and dual gate configurations. Single gate types are used for switches, choppers, and converters in telecommunications and industrial application. Dual gate devices are especially suitable for VHF/UHF antenna amplifier tuners.

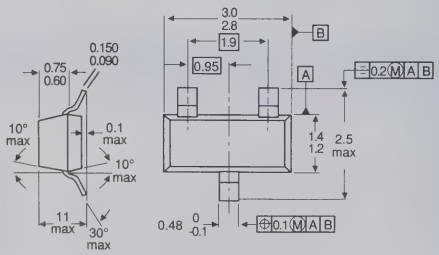
Vertical DMOSFET's: Offer medium and high drain-source voltages and source currents. Interdigitated metallization geometries produce lower input capacitances and thus, faster switching times than other types of DMOSFET's. Ideally suited for higher current and voltage applications.

Features

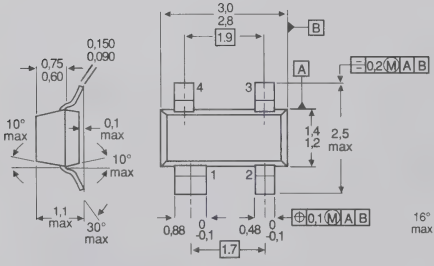
- High input impedance
- Low power consumption
- High dynamic range
- N and P-Channel polarities

Mechanical Data

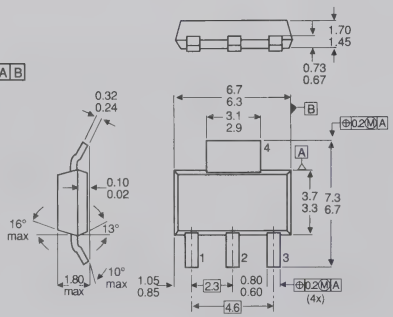
(Dimensions in mm)



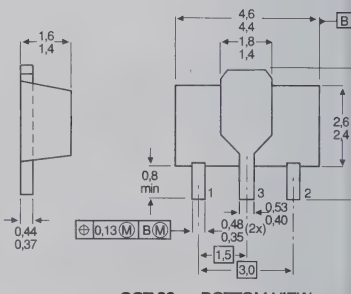
SOT-23 TOP VIEW



SOT-143 TOP VIEW



SOT-223



SOT-89 BOTTOM VIEW

Electrical Specifications

J FET's

Type	Package	Ratings		$r_{DS(on)}$ Max. Ω	$-I_{DSS}$ Min./Max. mA	$-V_{(P)GS}$ Max. V	C_{rs} Max. pF	Pinout
		V_{DS} V	V_{GSO} V					
N-Channel								
BF510	SOT-23	20	—	—	.07/3.0	0.8	0.4	B
BF511	SOT-23	20	—	—	2.5/7.0	1.5	0.4	B
BF512	SOT-23	20	—	—	6/12	2.2	0.4	B
BF513	SOT-23	20	—	—	10/18	3	0.4	B
BF545A/0	SOT-23	30	—	—	0.5/2.1	—	1.1 typ.	A
BF545A	SOT-23	30	—	—	2/6.5	—	1.1 typ.	A
BF545B	SOT-23	30	—	—	6/15	—	1.1 typ.	A
BF545C	SOT-23	30	—	—	12/25	—	1.1 typ.	A
BFR30	SOT-23	25	25	—	4/10	5	1.5	A
BFR31	SOT-23	25	25	—	1/5	2.5	1.5	A
BFT46	SOT-23	25	25	—	0.2/1.5	1.0	1.5	A
PMBFJ108	SOT-23	25	25	8	80/–	10	15	A
PMBFJ109	SOT-23	25	25	12	40/–	6	15	A
PMBFJ110	SOT-23	25	25	18	10/–	4	15	A
PZFJ108	SOT-223	25	25	8	80/–	10	15	A
PZFJ109	SOT-223	25	25	12	40/–	6	15	A
PZFJ110	SOT-223	25	25	18	10/–	4	15	A
PMBFJ308	SOT-23	25	—	—	12/60	—	2.5 typ.	A
PMBFJ309	SOT-23	25	—	—	12/30	—	2.5 typ.	A
PMBFJ310	SOT-23	25	—	—	24/60	—	2.5 typ.	A
PMBF4416	SOT-23	30	—	—	5/15	—	0.8 typ.	A
BFR101A*	SOT-143	30	30	—	0.2/1.5	1.0	—	C
BFR101B*	SOT-143	30	30	—	1/5	2.5	—	C
BSR56	SOT-23	40	40	25	50/–	10	5	A
BSR57	SOT-23	40	40	40	20/100	6	5	A
BSR58	SOT-23	40	40	60	8/80	4	5	A
PMBF4391	SOT-23	40	40	30	50/150	4-10	3.5	A
PMBF4392	SOT-23	40	40	60	25/75	2-5	3.5	A
PMBF4393	SOT-23	40	40	100	5/30	0.53	3.5	A
PMBFJ111	SOT-23	40	40	30	20/–	10	3 typ.	A
PMBFJ112	SOT-23	40	40	50	5/–	5	3 typ.	A
PMBFJ113	SOT-23	40	40	100	2/–	3	3 typ.	A
P-Channel								
PMBFJ174	SOT-23	30	30	85	20/135	10	4 typ.	A
PMBFJ175	SOT-23	30	30	125	7/70	6	4 typ.	A
PMBFJ176	SOT-23	30	30	250	2/35	4	4 typ.	A
PMBFJ177	SOT-23	30	30	300	1.5/20	2.25	4 typ.	A

MOSFET's

Type	Package	Mode	Ratings		g_{FS} (Typ) mA/V	$V_{(P)GS}$ Max. V	$R_{DS(on)}$ Max. I_D/V_{GS}		Pinout
			V_{DS} V	I_D mA			Ω	mA/V	
N-Channel									
BSD20*	SOT-143	Dp1	10	50	15	–2.0	30	1/10	C
BSS83*	SOT-143	Enh	10	50	15	2.0	45	0.1/10	C
BSD22*	SOT-143	Dp1	20	50	15	–2.0	30	1/10	C

*Includes integrated back-to-back diodes to protect against excessive input voltages.

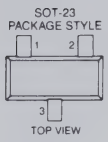
Dual Gate MOSFET's

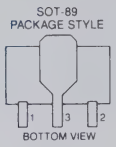
Type	Package	Ratings		NF	$-I_{GSS}$	I_{DSS}	$-V_{(P)GS}$	Y_{fs}	C_{rs}	Pinout
		V_{DS} V	I_D mA	Typ dB	Max. nA	Min./Max. mA	Max. V	Min. mA/V	Typ pF	
N-Channel										
BF998	SOT-143	12	30	0.6	50	4/20	2.0	21	.025	E
BF990	SOT-143	18	30	2.8	—	—	1.3	17	0.25	E
BF990A	SOT-143	18	—	2	—	—	1.3	18 Min	25	E
BF991	SOT-143	20	20	0.7	50	4/25	2.5	10	0.20	E
BF989	SOT-143	20	30	2.8	50	2/20	2.7	9.5	0.25	E
BF992	SOT-143	20	40	1.2	25	—	1.3	20	.04	E
BF994S	SOT-143	20	40	1.2	25	—	1.3	20	.04	E
BF996S	SOT-143	20	40	1.2	25	—	1.3	20	.04	E
BF997	SOT-143	20	30	1.0	50	2/20	2.0	15	.025	E

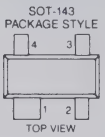
Vertical DMOS FET's

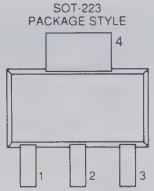
Type	Package	Ratings			Y_{FS} (Typ)	$V_{GS(TH)}$	$R_{DS\ (on)}$ Max. at I_D/V_{GS}		Pinout
		V_{DS} V	V_{GS} V	I_D mA	mA/V	V	Ω	mA/V	
N-Channel									
BSP103	SOT-223	35	20	750	170	0.8-2.0	5	300/5	T
BSN20	SOT-23	50	20	100	60	2.0	15	100/10	D
2N7002	SOT-23	60	40	180	200	0.8-3.0	5	500/10	D
BSP105	SOT-223	60	20	500	170	0.8-2.0	5	300/5	T
BSP106	SOT-223	60	15	500	200	0.8-3.0	5	200/10	T
BSP108	SOT-223	80	20	500	300	1.5-3.5	3	500/10	T
BSP110	SOT-223	80	20	325	150	0.8-2.8	7	200/10	T
BST80	SOT-89	80	20	400	300	1.5-3.5	4	500/10	D
BST82	SOT-23	80	20	175	150	1.6-3.5	10	150/5	D
BSP109	SOT-223	90	20	500	170	0.8-2.0	5.3	300/5	T
BST86	SOT-89	180	20	300	250	0.7-2.7	10	15/3	D
BST84	SOT-89	200	20	250	250	0.8-2.8	12	250/10	D
BSP107	SOT-223	200	20	200	180	0.8-2.4	28	20/2.6	T
BSP128	SOT-223	200	20	350	400	0.4-1.8	8	100/2.8	T
BSP120	SOT-223	200	20	250	250	0.8-2.8	12	250/10	T
BSP121	SOT-223	200	20	300	350	0.8-2.8	6	400/10	T
BSP122	SOT-223	200	—	650	800	1.0-3.0	2	1500/10	T
BSP126	SOT-223	250	20	300	400	0.8-2.0	6	300/10	T
P-Channel									
BSP205	SOT-223	50	20	250	150	1.5-3.5	10	200/10	T
BST122	SOT-89	50	20	250	125	1.5-3.5	6	200/10	D
BST120	SOT-89	60	20	300	200	1.5-3.5	10	200/10	D
BSP206	SOT-223	60	20	300	200	1.5-3.5	6	200/10	T
BSP220	SOT-223	200	20	250	200	0.8-2.24	12	200/10	T
BSS192	SOT-89	200	20	150	200	0.8-2.8	20	200/10	D
BSP225	SOT-223	250	20	250	200	0.8-2.8	15	200/10	T

Pinout Diagrams









	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT A: SOT-23	S	D	G	—
PINOUT B: SOT-23	D	G	S	—
PINOUT C: SOT-143	S	Sub.	D	G
PINOUT D: SOT-23	S	G	D	—
PINOUT D: SOT-89	S	G	D	—
PINOUT E: SOT-143	S	D	G_2	G_1
PINOUT T: SOT-223	G	D	S	D

Marking Codes

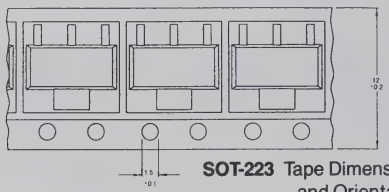
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BF510	S6p	BFR30	Mlp	BSP122	*	PMBF109	p09
BF511	S7p	BFR31	M2p	BSP126	*	PMBF110	p10
BF512	S8p	BFR101A	M97	BSP128	*	PMBF111	p11
BF513	S9p	BFR101B	M98	BSP205		PMBF112	p12
BF545A/0	*	BFT46	M3p	BSP206		PMBF113	p13
BF545A	*	BSD20	M31	BSP220	*	PMBF174	p6X
BF545B	*	BSD22	M32	BSP225	*	PMBF175	p6W
BF545C	*	BSN20	M8p	BSR56	M4p	PMBF176	p6S
BF989	MAp	BSP103	*	BSR57	M5p	PMBF177	p6Y
BF990	M90	BSP105	*	BSR58	M6p	PMBF308	M08
BF990A	M87	BSP106	*	BSS83	M74	PMBF309	M09
BF991	M91	BSP107	*	BSS192	*	PMBF310	M10
BF992	M92	BSP108	*	PMBF4416	*	PZFJ108	ZFJ108
BF994S	MGp	BSP109	*	PMBF4391	p6J	PZFJ109	ZFJ109
BF996S	MHp	BSP110	*	PMBF4392	p6K	PZFJ110	ZFJ110
BF997	MKp	BSP120	*	PMBF4393	p6G	2N7002	702
BF998	MOp	BSP121	*	PMBFJ108	p08		

*See individual device data sheet.

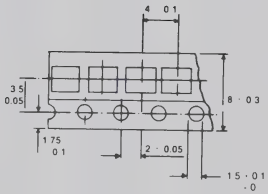
Tape and Reel Specifications

(Dimensions in mm)

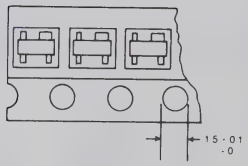
SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



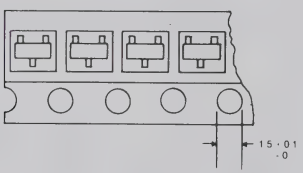
SOT-223 Tape Dimensions and Orientation



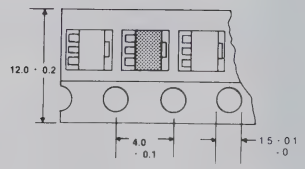
SOT-23 and SOT-143
Tape Dimensions



SOT-143
Orientation



SOT-23
Orientation



SOT-89
Tape Dimensions and Orientation

SMD® Temperature Sensors

Description

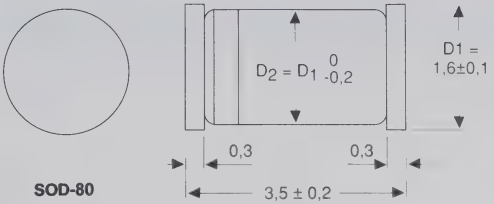
Philips Components offers surface mount temperature sensors having a measuring temperature range of −40 to +125°C, tolerances as low as 1%, and a wide range of center resistance. These sensors are extremely stable and more linear than NTC thermistors. Applications range from basic domestic temperature control to the most advanced industrial microprocessor-based control systems.

Features

- Measuring temperature range −40 to +125°C
- Tolerances from 1% to 5%
- Excellent linearity over a wide temperature range
- SOD-80 for low cost, hermetic glass packaging

Mechanical Data

(Dimensions in mm)



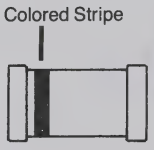
SOD-80

Electrical Specifications

Type	Package	Tolerance Class	Measuring Temp Range (°C)	Resistance (Typ @ 25°C) (Ω)	Thermal Time Constant		Temperature Coefficient (%/°C)
					Still Air (sec)	Still Liquid (sec)	
KTY85-110	SOD-80	± 1%	−25 to +125	1000	20	1	0.75
KTY85-120	SOD-80	± 2%	−25 to +125	1000	20	1	0.75
KTY85-150	SOD-80	± 5%	−25 to +125	1000	20	1	0.75

Polarity and Marking Codes

Sensor must be operated with the lower potential at the end indicated by the colored stripe.

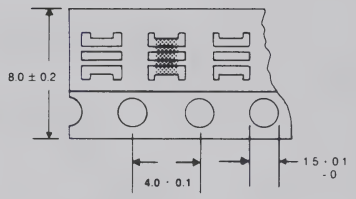


Type No.	Stripe Color
KTY85-110	Yellow
KTY85-120	White or Green
KTY85-150	Black or Blue

Tape and Reel Specifications

(Dimensions in mm)

SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOD-80	2.5K 10K	7 13	8 8	TRL TRL 13



SOD-80
Tape Dimensions
and Orientation

(Standard Diode Orientations is
Cathode Band at Sprocket Hole Side.)

SMD® Trigger Devices (PNPN)

Description

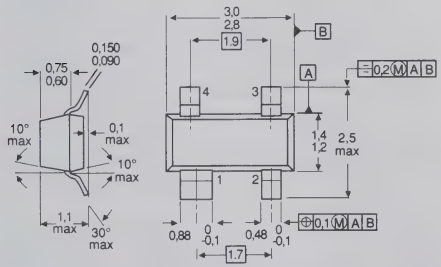
Philips Components trigger devices are planar P-N-P-N devices which can be used as programmable unijunction transistors (PUTs) or silicon controlled switches to switch relay and lamp drivers, sense temperature changes, and trigger thyristors and triacs. Applications include motor control, oscillators, timers, and pulse shapers.

Features

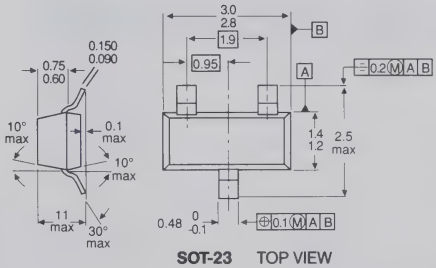
- 70V gate-anode voltage
- Continuous anode current up to 175 mA
- Surge currents as high as 3A
- Compatible with wave or reflow soldering

Mechanical Data

(Dimensions in mm)



SOT-143 TOP VIEW

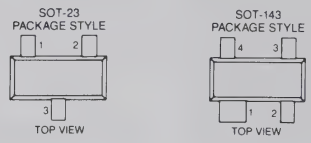


SOT-23 TOP VIEW

Electrical Specifications

Type	Package	V_{GA} Max V	I_A Max mA	I_D µA	I_V µA	Pinout
BRY61	SOT-23	70	175	5/1	30/50	N
BRY62	SOT-143	70	175	—	—	P

Pinout Diagrams



	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT N: SOT-23	K	A	ANODE GATE	—
PINOUT P: SOT-143	ANODE GATE	A	K	CATHODE GATE

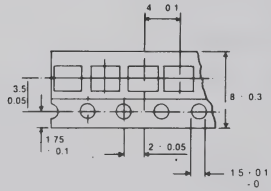
Marking Codes

Type No.	Code
BRY61	A5p
BRY62	A51p

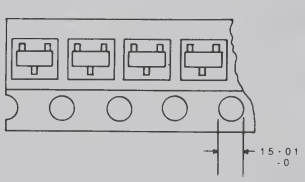
Tape and Reel Specifications

(Dimensions in mm)

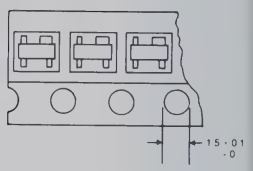
SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL13



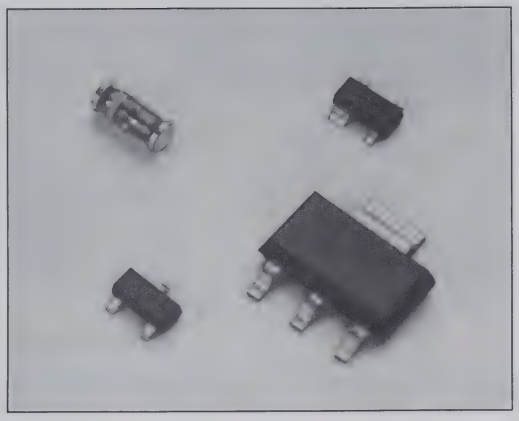
SOT-23 and SOT-143
Tape Dimensions



SOT-23
Orientation



SOT-143
Orientation



SMD® Switching Diodes

Description

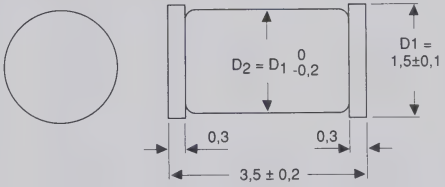
Philips Components diodes for switching applications combine the highest quality standards with state-of-the-art production equipment to fulfill the need for generic, low-cost devices. These switching diodes offer a broad range of current ratings, reverse breakdown voltages and switching specifications to address a variety of circuit requirements. They are offered in a choice of surface mount packages, providing the designer with alternatives for different power requirements, circuit board substrate materials, and assembly processing techniques.

Features

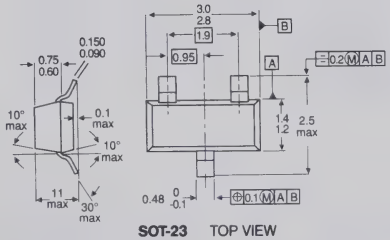
- Reverse breakdown voltages up to 200V
- Switching times as low as 2 ns
- Dual diodes in SOT-23 and SOT-143
- SOD-80C using "Implosion" technology for low cost, hermatic glass packaging.

Mechanical Data

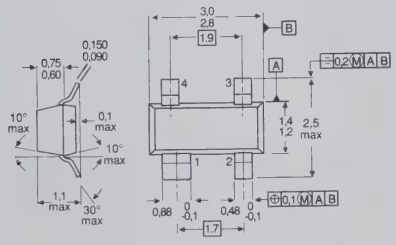
(Dimensions in mm)



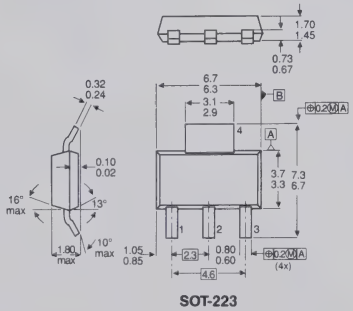
SOD-80C



SOT-23 TOP VIEW



SOT-143 TOP VIEW



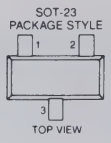
SOT-223

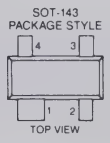
Electrical Specifications

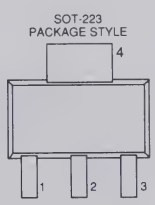
Type	Package	Ratings		V_F				Pinout
		V_R V	I_F mA	mV	@ I_F mA	t_{rr}(max) ns	C_d(max) pF	
BAS16	SOT-23	75	250	1240	150	6	2	H
BAS19	SOT-23	100	200	1000	100	50	5	H
BAS20	SOT-23	150	200	1000	100	50	5	H
BAS21	SOT-23	200	200	1000	100	50	5	H
BAS28*	SOT-143	75	250	1000	100	50	5	J
BAS29	SOT-23	90	250	900	100	50	35	H
BAS31*	SOT-23	90	250	900	100	50	35	K
BAS32L	SOD-80C	75	200	1000	100	4	2	—
BAS35*	SOT-23	90	100	900	100	50	35	L
BAS56*	SOT-143	60	200	1000	200	6	2.5	J
BAV23*	SOT-143	200	200	1000	100	50	5	J
BAV23S*	SOT-223	200	200	1000	100	50	5	K
BAV70*	SOT-23	70	250	1250	150	6	1.5	M
BAV74*	SOT-23	50	100	1000	100	4	2	M
BAV99*	SOT-23	70	250	1250	150	6	1.5	K
BAV100	SOD-80C	50	250	1000	100	50	5	—
BAV101	SOD-80C	100	250	1000	100	50	5	—
BAV102	SOD-80C	150	250	1000	100	50	5	—
BAV103	SOD-80C	200	250	1000	100	50	5	—
BAV105	SOD-80C	60	600	1000	200	6	2	—
BAW56*	SOT-23	70	250	1250	150	6	2	L
PMBD914	SOT-23	100	200	1000	10	15	4	H
PMBD2835*	SOT-23	35	100	1200	100	15	4	L
PMBD2836*	SOT-23	75	100	1200	100	15	4	L
PMBD2837*	SOT-23	35	100	1200	100	15	4	M
PMBD2838*	SOT-23	75	100	1200	100	15	4	M
PMBD6050	SOT-23	70	200	1100	100	15	2.5	H
PMBD6100*	SOT-23	70	200	1100	100	15	2.5	M
PMBD7000*	SOT-23	100	200	1100	100	15	1.5	K
PMLL4148	SOD-80C	75	200	1000	100	4	4	—
PMLL4150	SOD-80C	50	300	920	100	4	2.5	—
PMLL4151	SOD-80C	75	200	1000	50	2	2	—
PMLL4153	SOD-80C	75	200	880	20	2	2	—
PMLL4446	SOD-80C	75	200	1000	100	4	4	—
PMLL4448	SOD-80C	75	200	1000	100	4	4	—

*Dual Diode

Pinout Diagrams







	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT H: SOT-23	N.C.	A	K	—
PINOUT J: SOT-143	K_1	K_2	A_2	A_1
PINOUT K: SOT-23	K_1	A_2	K_2,A_1	—
PINOUT K: SOT-223	K_1	A_2	K_2,A_1	N.C.
PINOUT L: SOT-23	K_1	K_2	K_1,A_2	—
PINOUT M: SOT-23	A_1	A_2	K_1,K_2	—

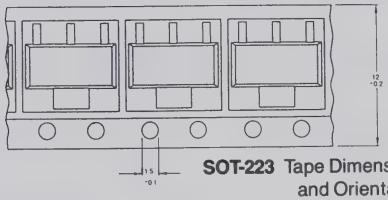
Marking Codes

Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BAS16	A6p	BAS31	L21	BAV74	JAp	PMBD2837	pA5
BAS19	JPp	BAS35	L22	BAV99	A7p	PMBD2838	pA6
BAS20	JRp	BAS56	L51	BAW56	A1p	PMBD6050	p5A
BAS21	JSp	BAV23	L30	PMBD914	p5D	PMBD6100	p5B
BAS28	JTp	BAV23S	L31	PMBD2835	pA3	PMBD7000	p5C
BAS29	L20	BAV70	A4p	PMBD2836	pA2		

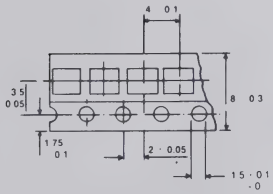
Tape and Reel Specifications

(Dimensions in mm)

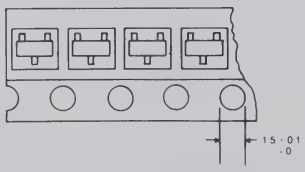
SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13
SOD-80C	2.5K	7	8	TRL
	10K	13	8	TRL 13



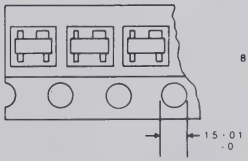
SOT-223 Tape Dimensions and Orientation



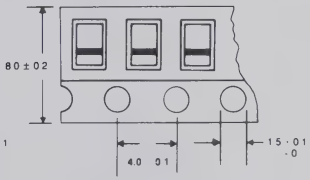
SOT-23 and SOT-143 Tape Dimensions



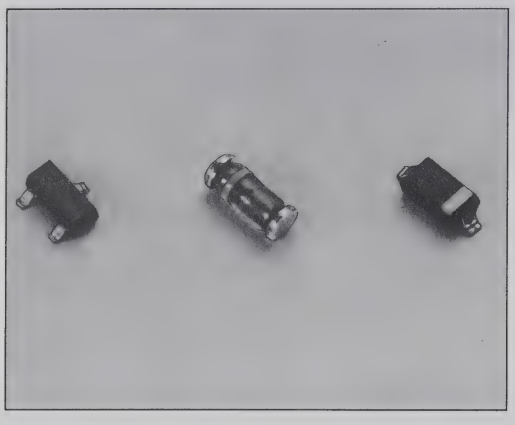
SOT-23 Orientation



SOT-143 Orientation



SOD-80C Tape Dimensions and Orientation



SMD® Bandswitch Diodes

Description

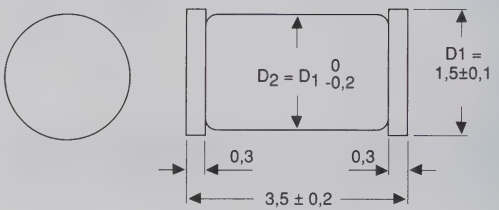
Philips Components bandswitch diodes are intended specifically for use in radio, television, and other tuning applications. Primary attributes are extremely low dynamic capacitance and series resistance.

Features

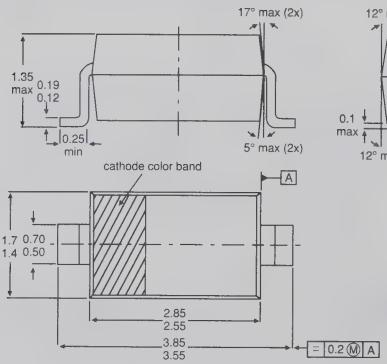
- Guaranteed maximum dynamic capacitance as low as 1.2 pF at 3V reverse voltage
- Guaranteed maximum dynamic resistances as low as 0.7Ω at 3 mA
- SOD-80C using "Implosion" technology for low cost, hermetic glass packaging.

Mechanical Data

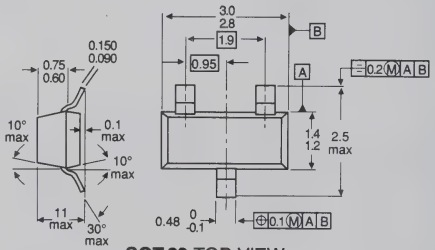
(Dimensions in mm)



SOD-80C



SOD-123

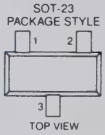


SOT-23 TOP VIEW

Electrical Specifications

Type	Package	Ratings		$C_{d(max)}$		$r_{D(max)}$			Pinout
		V_R V	I_F mA	@ V_R pF	V	@ I_F Ω	mA	@ f MHz	
BA423L	SOD-80C	20	50	3.5	6	1.5	10	100	—
BA582	SOD-123	35	100	1.25	3	0.7	3	200	—
BA682	SOD-80	35	100	1.25	3	0.7	3	200	—
BA683	SOD-80	35	100	1.20	3	1.2	3	200	—
BAT18	SOT-23	35	100	1.00	20	0.7	5	200	H

Pinout Diagrams



PINOUT H: SOT-23

PIN 1	PIN 2	PIN 3
N.C.	A	K

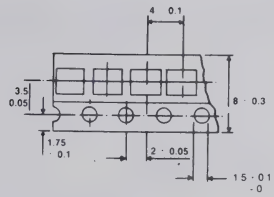
Marking Codes

Type No.	Code
BAT18	A2p

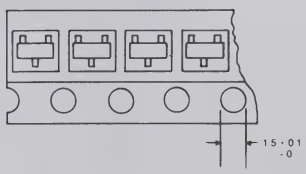
Tape and Reel Specifications

(Dimensions in mm)

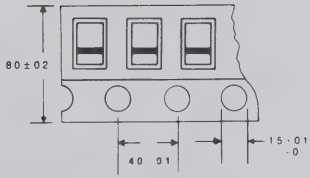
SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOD-80C	2.5K	7	8	TRL
	10K	13	8	TRL 13



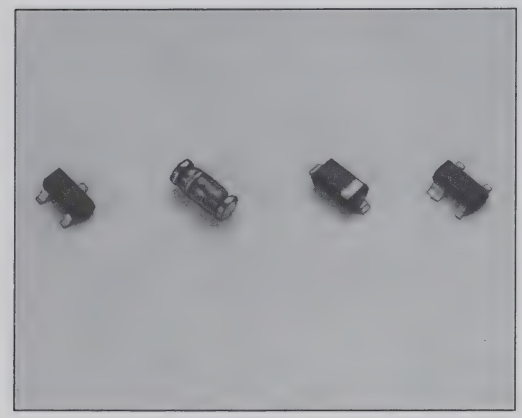
SOT-23
Tape Dimensions



SOT-23
Orientation



SOD-80C
Tape Dimensions
and Orientation



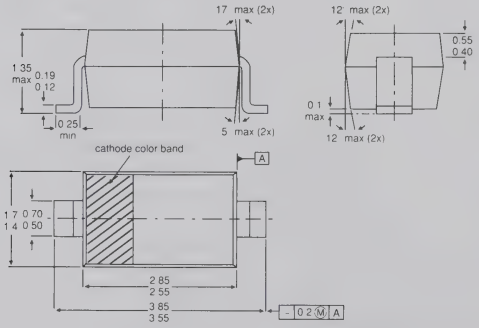
Variable Capacitance SMD® Diodes

Description

Philips Components variable capacitance (varicap) diodes are optimized to exhibit linear, highly dependable dynamic capacitance characteristics over the entire rated range of reverse voltage values. The devices also have very low series resistance and can be used in all AM, FM, VHF and UHF circuits where tuning is required. They are offered in a choice of surface mount packages, providing the designer with alternatives for different power requirements, circuit board substrate materials, and assembly processing techniques.

Features

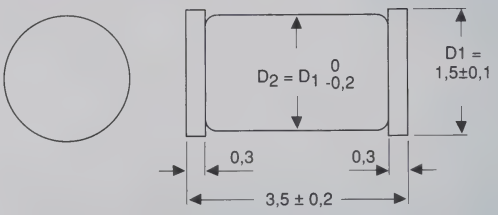
- Guaranteed minimum and maximum capacitance ratio over working voltage range
- Operating reverse voltage ranges from 0.5V to 28V
- Typical series resistance as low as 0.2Ω
- Dual diodes in SOT-23 and SOT-143
- SOD-80C using "Implosion" technology for low cost, hermetic glass packaging.



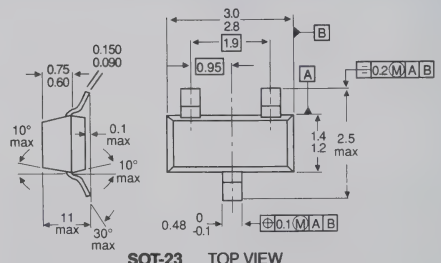
SOD-123

Mechanical Data

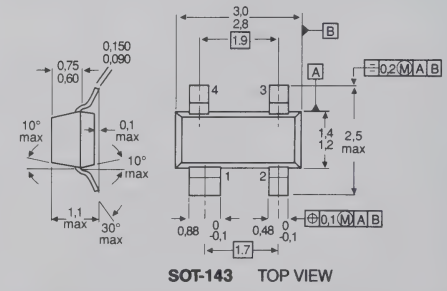
(Dimensions in mm)



SOD-80C



SOT-23 TOP VIEW



SOT-143 TOP VIEW

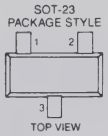
Electrical Specifications

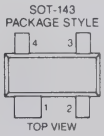
Type	Package	Ratings V_R V	Ratings I_F mA	C_d at V_R pF	C_d at V_R V	C_d Ratio f = 1 MHz Min.	Typ.	Max.	@ V1/V2	r_s Max. Ω	Pinout
BB215	SOD-80C	30	20	18 Min.	1	7.6	—	—	1/28	—	—
BB219	SOD-80C	30	20	31 Min.	1	12	—	—	1/28	—	—
BB240	SOD-80C	32	20	2.3-2.7	28	14	—	—	0.5/28	1.0	—
BB241	SOD-80C	32	20	2.6-3.0	28	21	—	—	0.5/28	2.0	—
BB249	SOD-80C	28	20	4.0-5.0	28	8	—	10	1/28	0.6	—
BB515	SOD-123	—	—	1.85-2.25	28	8	—	9.6	1/28	0.5 typ.	—
BB619	SOD-123	—	—	2.4-2.9	28	12.5	—	—	1/28	0.7 typ.	—
BB620	SOD-123	—	—	2.9-3.4	28	19.5	—	25	1/28	1.3	—
BB804	SOT-23	18	50	44.5 typ.	2	1.65	—	1.75	2/8	0.2	L
BB811	SOD-123	—	—	0.85-1.2	28	7.8	—	9.5	1/28	1.0 typ.	—
BBY31	SOT-23	28	20	1.8-2.8	25	—	5	—	3/25	1.2	H
BBY39*	SOT-23	30	20	1.8-2.0	28	7.6	—	—	1/28	0.8	M
BBY40	SOT-23	28	20	4.3-6	25	5	—	5.6	3/25	0.6	H
BBY42	SOT-23	32	50	31 Min.	1	12	—	16	1/28	1.2	H
BBY62*	SOT-143	30	50	17.5 typ.	1	—	5	—	3/25	1.0	J

*Dual diode

Pinout Diagrams

	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT H: SOT-23	N.C.	A	K	—
PINOUT J: SOT-143	K_1	K_2	A_2	A_1
PINOUT L: SOT-23	K_1	K_2	K_1,K_2	—
PINOUT M: SOT-23	A_1	K_2	K_1,A_2	—





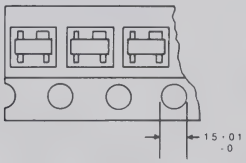
Type No.	Code	Type No.	Code	Type No.	Code
BB804	S3p	BBY39	S12	BBY42	S13
BBY31	S1p	BBY40	S2p	BBY62	S3p

*See individual device data sheet

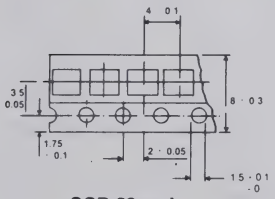
Tape and Reel Specifications

(Dimensions in mm)

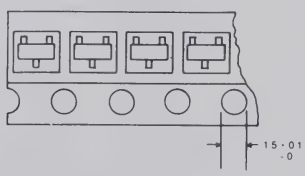
SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOD-80C	2.5K	7	8	TRL
	10K	13	8	TRL 13



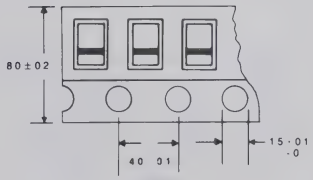
SOT-143
Orientation



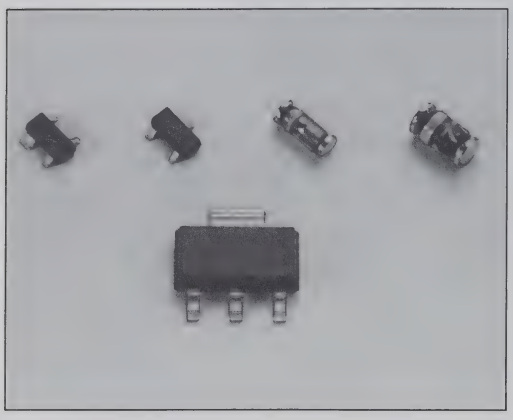
SOD-23 and SOT-143
Tape Dimensions



SOT-23
Orientation



SOD-80C
Tape Dimensions
and Orientation



SMD® Schottky Diodes

Description

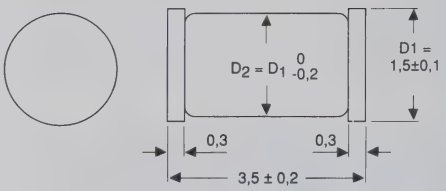
Philips Components Schottky barrier diodes are metal junction devices which combine the attributes of low forward voltage drop with fast switching times. Specific applications include battery back-up circuits, overshoot/ undershoot protection, and voltage reference. They are offered in a choice of surface mount packages, providing the designer with alternatives for different power requirements, circuit board substrate materials, and assembly processing techniques.

Features

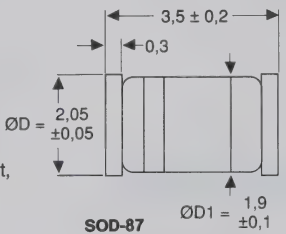
- V_F as low as 400 mV at 10 mA
- Switching times under 1 ns
- Continuous current ratings up to 1A
- Dual diodes in SOT-23 and SOT-143
- SOD-80C using "Implosion" technology for low cost, hermetic glass packaging.

Mechanical Data

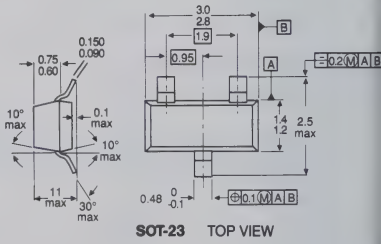
(Dimensions in mm)



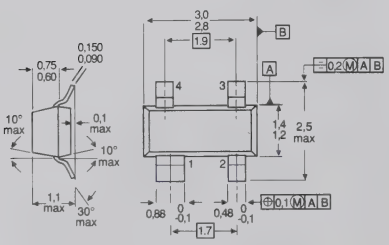
SOD-80C



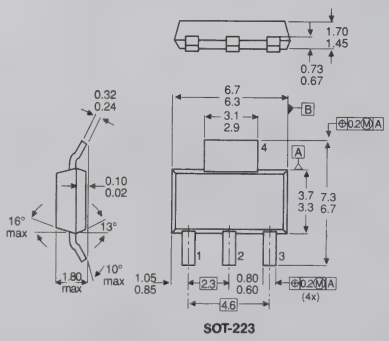
SOD-87



SOT-23 TOP VIEW



SOT-143 TOP VIEW



SOT-223

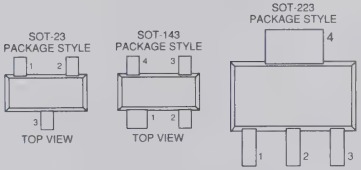
Philips Semiconductors 100 Providence Pike, Slatersville, RI 02876-2078 (401) 762-3800

Electrical Specifications

Type	Package	Ratings		C_d (max)		V_F		I_R		Pinout
		V_R V	I_F mA	pF	@ V_R V	mV	@ I_F mA	Max. μA	@ V_R V	
PMBD101	SOT-23	4	10	1	0	600	10	0.25	3	H
PMBD352*	SOT-23	4	10	1	0	600	10	0.25	3	K
PMBD353*	SOT-23	4	10	1	0	600	10	0.25	3	U
BAT17	SOT-23	4	30	1	0	600	10	0.25	3	H
PRLL5817	SOD-87	20	1000	70	4	450	1000	1000	20	—
PRLL5818	SOD-87	30	1000	50	4	550	1000	500	30	—
BAS85	SOD-80C	30	200	10	1	400	10	2.0	25	—
BAT54	SOT-23	30	200	10	1	400	10	2.0	25	H
BAT74*	SOT-143	30	200	10	1	400	10	2.0	25	J
BAT54A*	SOT-23	30	200	10	1	400	10	2.0	25	L
BAT54C*	SOT-23	30	200	10	1	400	10	2.0	25	M
BAT54S*	SOT-23	30	200	10	1	400	10	2.0	25	K
PBYR235CT	SOT-223	35	2000	100 typ.	5	0.45	1000	100	35	AA
PBYR240CT	SOT-223	40	2000	100 typ.	5	0.45	1000	100	40	AA
PRLL5819	SOD-87	40	1000	50	4	600	1000	500	40	—
PBYR245CT	SOT-223	45	2000	100 typ.	5	0.45	1000	100	45	AA
BAS86	SOD-80C	50	200	8	1	600	10	5.0	40	—

*Dual Diode

Pinout Diagrams

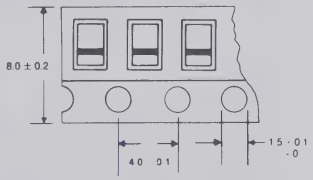


	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT H: SOT-23	N.C.	A	K	—
PINOUT J: SOT-143	K_1	K_2	A_2	A_1
PINOUT K: SOT-23	K_1	A_2	K_2,A_1	—
PINOUT L: SOT-23	K_1	K_2	A_1,A_2	—
PINOUT M: SOT-23	A_1	A_2	K_1,K_2	—
PINOUT U: SOT-23	A_1	K_2	K_1,A_2	—
PINOUT AA: SOT-223	A_1	K_1,K_2	A_2	K_1,K_2

Marking Codes

Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BAS85	*	BAT54C	L43	PBYR245CT	*	PRLL5818	*
BAS86	*	BAT54S	L44	PMBD101	p4M	PRLL5819	*
BAT17	A3p	BAT74	L41	PMBD352	p5G		
BAT54	L4p	PBYR235CT	*	PMBD353	p4F		
BAT54A	L42	PBYR240CT	*	PRLL5817	*		

*See individual device data sheet.

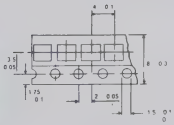


SOD-80C and SOD-87 Tape Dimensions and Orientation

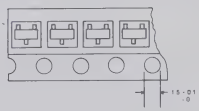
Tape and Reel Specifications

(Dimensions in mm)

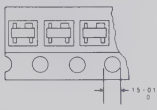
SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13
SOD-80C	2.5K	7	8	TRL
	10K	13	8	TRL 13
SOD-87	2K	7	8	TRL



SOT-23 and SOT-143 Tape Dimensions

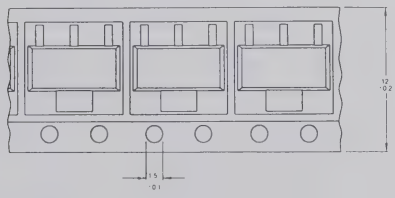


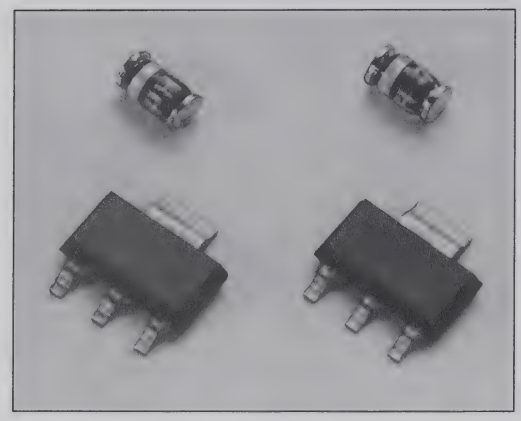
SOT-23 Orientation



SOT-143 Orientation

SOT-223 Tape Dimensions and Orientation





SMD® Rectifiers

Description

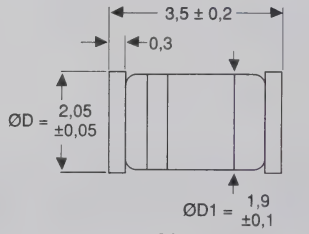
Philips Components 1 Amp rectifier diodes in the SOD-87 hermetic glass MELF package are encapsulated using a state-of-the-art implosion technology. The SOD-87 package is created by heating the chip, studs, and glass sleeve in a vacuum chamber, then collapsing the vacuum and allowing implosion of the glass sleeve. The result is a high-quality, void-free, low resistance pressure contact between the metal stud leads and the rectifier chip.

Features

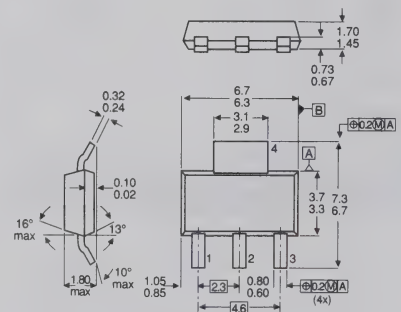
- Low cost general purpose devices
- Versatile high-speed devices guaranteed for 250 ns switching times
- Ultrafast device specified for switching speeds under 25 ns
- Unique 3.5 mm package length allows board space savings
- SOT-223 for 1W power 2 ±60°C on printed curcuit boards

Mechanical Data

(Dimensions in mm)



SOD-87

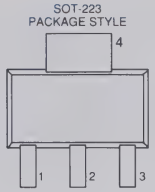


SOT-223

Electrical Specifications

Type	Package	$I_{F(AV)}$(Max) (A)	V_{RRM} (V)	I_{FSM} (A)	V_F(Max) (V)	I_F (A)	t_{rr}(Max) (ns)	Pinout
General Purpose								
BYD17D	SOD-87	1.5	200	20	1.05	1	—	
BYD17G	SOD-87	1.5	400	20	1.05	1	—	
BYD17J	SOD-87	1.5	600	20	1.05	1	—	
BYD17K	SOD-87	1.5	800	20	1.05	1	—	
BYD17M	SOD-87	1.5	1000	20	1.05	1	—	
PRLL4001	SOD-87	1.5	50	20	.08	1	—	
PRLL4002	SOD-87	1.5	100	20	.08	1	—	
Fast Recovery								
BYD37D	SOD-87	1.5	200	20	1.3	1	250	
BYD37G	SOD-87	1.5	400	20	1.3	1	250	
BYD37J	SOD-87	1.5	600	20	1.3	1	250	
BYD37K	SOD-87	1.5	800	20	1.3	1	300	
BYD37M	SOD-87	1.5	1000	20	1.3	1	300	
Very Fast Recovery								
BYD77A	SOD-87	2	50	25	0.95	1	25	
BYD77B	SOD-87	2	100	25	0.95	1	25	
BYD77C	SOD-87	2	150	25	0.95	1	25	
BYD77D	SOD-87	2	200	25	0.95	1	25	
BYD77E	SOD-87	1.85	250	25	1.05	1	50	
BYD77F	SOD-87	1.85	300	25	1.05	1	50	
BYD77G	SOD-87	1.85	400	25	1.05	1	50	
BYV40-100	SOT-223	1.5	100	2 × 6A	1	1.5	50	AA
BYV40-150	SOT-223	1.5	150	2 × 6A	1	1.5	50	AA
BYV40-200	SOT-223	1.5	200	2 × 6A	1	1.5	50	AA

Pinout Diagrams



PINOUT AA:
SOT-223

PIN 1 PIN 2 PIN 3 PIN 4

A_1 K_1K_2 A_2 K_1K_2

Marking Code

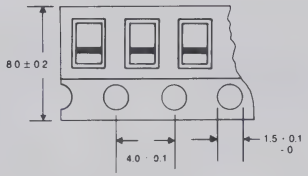
Type No.	Code
BYV40-100	*
BYV40-150	*
BYV40-200	*

*See individual device data sheet.

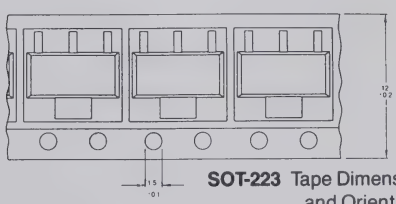
Tape and Reel Specifications

(Dimensions in mm)

SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOD-87	2K	7	8	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



SOD-87
Tape Dimensions
and Orientation
(Standard Diode Orientation is
Cathode Band at Sprocket Hole Side)



SOT-223 Tape Dimensions
and Orientation

Voltage Reference SMD® Diodes

Description

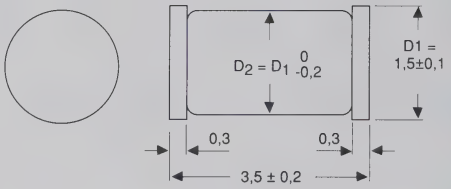
Philips Components voltage reference series is composed of stabistors (low voltage stabilizing diodes) and temperature compensating 6.2V reference diodes. Primary applications are for voltage bias stabilization and signal clipping and clamping.

Features

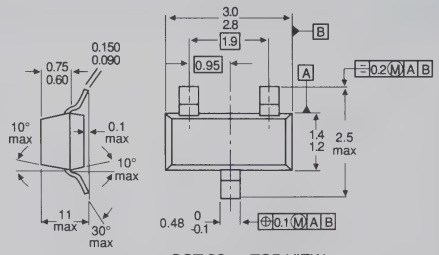
- Guaranteed temperature coefficients less than 0.005%/°C
- Differential resistance less than 6Ω @ 10 mA
- Compatible with wave or reflow soldering
- SOD-80C using "Implosion" Technology for low cost, hermetic glass packaging.

Mechanical Data

(Dimensions in mm)



SOD-80C



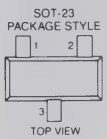
SOT-23 TOP VIEW

Electrical Specifications

Type	Package	Description	Reference Voltage		Temperature Coefficient	Pinout
			V	@ mA		
BA314L	SOD-80C	Stabistor	0.85-0.94	100	– 1.8mV/°C	—
BAS17	SOT-23	Stabistor	0.87-0.96	100	– 1.8mV/°C	H
BZV80	SOD-80C	6.2V Reference	5.89-6.51	7.5	0.01%/°C	—
BZV81	SOD-80C	6.2V Reference	5.89-6.51	7.5	0.005%/°C	—

Pinout Diagrams

	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT H: SOT-23	N.C.	A	K	—



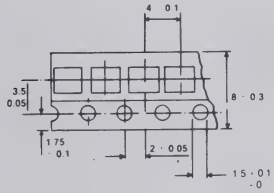
Marking Codes

Type No.	Code
BAS17	A91

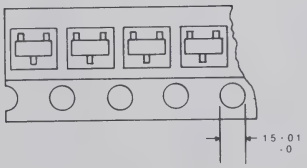
Tape and Reel Specifications

(Dimensions in mm)

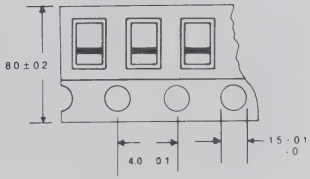
SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL13
SOD-80C	2.5K	7	8	TRL
	10K	13	8	TRL 13



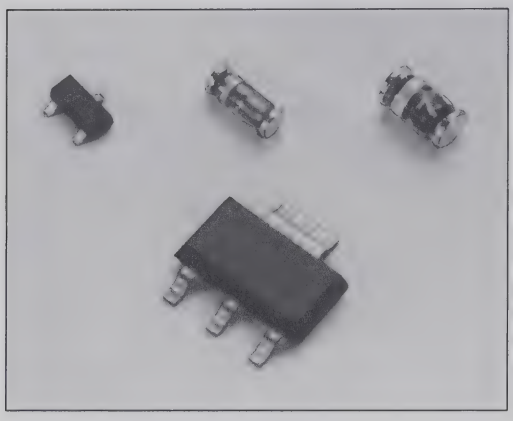
SOT-23
Tape Dimensions



SOT-23
Orientation



SOD-80C
Tape Dimensions
and Orientation



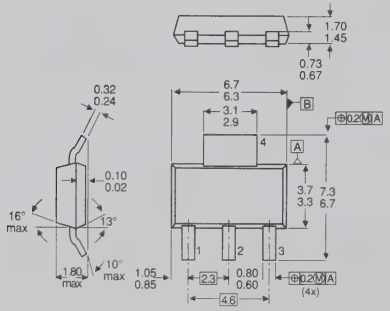
SMD® ZENER Diodes

Description

Philips Components ZENER diodes combine the highest quality standards with state-of-the-art production equipment to fulfill the need for generic, low-cost devices. This family offers a broad range of nominal voltage values, test current limits, and dynamic resistance specifications to address the multitude of circuit requirements. They are offered in a choice of surface mount packages, providing the designer with alternatives for different power requirements, circuit board substrate materials and assembly processing techniques.

Features

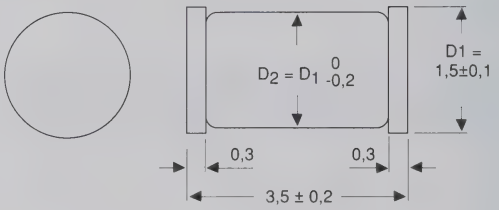
- 1W ZENER in SOT-223
- Nominal voltage ranges from 2.4V to 510V
- ZENER voltage tolerances from 1% to 5%
- SOD-87 for up to 2.3W power dissipation rating
- SOD-80C using "Implosion" technology for low cost, hermetic glass packaging.



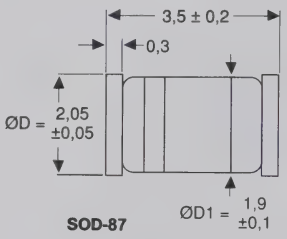
SOT-223

Mechanical Data

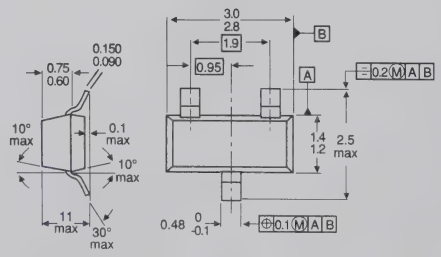
(Dimensions in mm)



SOD-80C



SOD-87



SOT-23 TOP VIEW

Electrical Specifications, 500mW, SOD-80C Package

Type	V_Z (Nom)*		ZENER Impedance			Temperature Coefficient	I_R(Max)	
			Z_{zt} (Max)		Z_{zk}(Max)			
	(V)	@ IZ (mA)	Ω	@ i_{ZT} (mA)	@ IZK = 0.25mA (Ω)	θvz (Max) (%/°C)	(μA)	@ V_R (V)
PMLL5225B	3.0	20	29	20	1600	−0.075	50	1.0
PMLL5226B	3.3	20	28	20	1600	−0.070	25	1.0
PMLL5227B	3.6	20	24	20	1700	−0.065	15	1.0
PMLL5228B	3.9	20	23	20	1900	−0.070	10	1.0
PMLL5229B	4.3	20	22	20	2000	±0.055	5.0	1.0
PMLL5230B	4.7	20	19	20	1900	±0.030	5.0	2.0
PMLL5231B	5.1	20	17	20	1600	±0.030	5.0	2.0
PMLL5232B	5.6	20	11	20	1600	+0.038	5.0	3.0
PMLL5233B	6.0	20	7	20	1600	+0.038	5.0	3.5
PMLL5234B	6.2	20	7	20	1000	+0.045	5.0	4.0
PMLL5235B	6.8	20	5	20	750	+0.050	3.0	5.0
PMLL5236B	7.5	20	6	20	500	+0.058	3.0	6.0
PMLL5237B	8.2	20	8	20	500	+0.062	3.0	6.5
PMLL5238B	8.7	20	8	20	600	+0.065	3.0	6.5
PMLL5239B	9.1	20	10	20	600	+0.068	3.0	7.0
PMLL5240B	10	20	17	20	600	+0.075	3.0	8.0
PMLL5241B	11	20	22	20	600	+0.076	2.0	8.4
PMLL5242B	12	20	30	20	600	+0.077	1.0	9.1
PMLL5243B	13	9.5	13	9.5	600	+0.079	0.5	9.9
PMLL5244B	14	9.5	15	9.0	600	+0.082	0.1	10
PMLL5245B	15	8.5	16	8.5	600	+0.082	0.1	11
PMLL5246B	16	7.8	17	7.8	600	+0.083	0.1	12
PMLL5247B	17	7.4	19	7.4	600	+0.084	0.1	13
PMLL5248B	18	7.0	21	7.0	600	+0.085	0.1	14
PMLL5249B	19	6.6	23	6.6	600	+0.086	0.1	14
PMLL5250B	20	6.2	25	6.2	600	+0.086	0.1	15
PMLL5251B	22	5.6	29	5.6	600	+0.087	0.1	17
PMLL5252B	24	5.2	33	5.2	600	+0.088	0.1	18
PMLL5253B	25	5.0	35	5.0	600	+0.089	0.1	19
PMLL5254B	27	4.6	41	4.6	600	+0.090	0.1	21
PMLL5255B	28	4.5	44	4.5	600	+0.091	0.1	21
PMLL5256B	30	4.2	49	4.2	600	+0.091	0.1	23
PMLL5257B	33	3.8	58	3.8	700	+0.092	0.1	25
PMLL5258B	36	3.4	70	3.4	700	+0.093	0.1	27
PMLL5259B	39	3.2	80	3.2	800	+0.094	0.1	30
PMLL5260B	43	3.0	93	3.2	900	+0.095	0.1	33
PMLL5261B	47	2.7	105	2.7	1000	+0.095	0.1	36
PMLL5262B	51	2.5	125	2.5	1100	+0.096	0.1	39
PMLL5263B	56	2.2	150	2.2	1300	+0.096	0.1	43
PMLL5264B	60	2.1	170	2.1	1400	+0.097	0.1	46
PMLL5265B	62	2.0	185	2.0	1400	+0.097	0.1	47
PMLL5266B	68	1.8	230	1.8	1600	+0.097	0.1	52
PMLL5267B	75	1.7	270	1.7	1700	+0.098	0.1	56

*Tolerance = ±5%

(continued)

Electrical Specifications, 500 mW, SOD-80C Package (continued)

Type	ZENER Voltage* V_Z at I_Z			Maximum Differential Resistance t_{diff} at I_Z		Maximum Temperature Coefficient S_Z at I_Z		Maximum Reverse Current I_R at V_R	
	V								
	Min	Max	mA	Ω	mA	mV/°C	mA	μA	V
BZV55C2V4	2.2	2.6	5	100	5	−3.5	5	50	1
BZV55C2V7	2.5	2.9	5	100	5	−3.5	5	20	1
BZV55C3V0	2.8	3.2	5	95	5	−3.5	5	10	1
BZV55C3V3	3.1	3.5	5	95	5	−3.5	5	5	1
BZV55C3V6	3.4	3.8	5	90	5	−3.5	5	5	1
BZV55C3V9	3.7	4.1	5	90	5	−3.5	5	3	1
BZV55C4V3	4.0	4.6	5	90	5	−3.5	5	3	1
BZV55C4V7	4.4	5.0	5	80	5	−3.5	5	3	2
BZV55C5V1	4.8	5.4	5	60	5	−2.7	5	2	2
BZV55C5V6	5.2	6.0	5	40	5	2.5	5	1	2
BZV55C6V2	5.8	6.6	5	10	5	3.7	5	3	4
BZV55C6V8	6.4	7.2	5	15	5	4.5	5	2	4
BZV55C7V5	7.0	7.9	5	15	5	5.3	5	1	5
BZV55C8V2	7.7	8.7	5	15	5	6.2	5	.700	5
BZV55C9V1	8.5	9.6	5	15	5	7.0	5	.500	6
BZV55C10	9.4	10.6	5	20	5	8.0	5	.200	7
BZV55C11	10.4	11.6	5	20	5	9.0	5	.100	8
BZV55C12	11.4	12.7	5	25	5	10.0	5	.100	8
BZV55C13	12.4	14.1	5	30	5	11.0	5	.100	8
BZV55C15	13.8	15.6	5	30	5	13.0	5	.050	$0.7V_Z$ nom
BZV55C16	15.3	17.1	5	40	5	14.0	5	.050	$0.7V_Z$ nom
BZV55C18	16.8	19.1	5	45	5	16.0	5	.050	$0.7V_Z$ nom
BZV55C20	18.8	21.2	5	55	5	18.0	5	.050	$0.7V_Z$ nom
BZV55C22	20.8	23.3	5	55	5	20.0	5	.050	$0.7V_Z$ nom
BZV55C24	22.8	25.6	5	70	5	22.0	5	.050	$0.7V_Z$ nom
BZV55C27	25.1	28.9	2	80	2	25.3	2	.050	$0.7V_Z$ nom
BZV55C30	28.0	32.0	2	80	2	29.4	2	.050	$0.7V_Z$ nom
BZV55C33	31.0	35.0	2	80	2	33.4	2	.050	$0.7V_Z$ nom
BZV55C36	34.0	38.0	2	90	2	37.4	2	.050	$0.7V_Z$ nom
BZV55C39	37.0	41.0	2	130	2	41.2	2	.050	$0.7V_Z$ nom
BZV55C43	40.0	46.0	2	150	2	46.6	2	.050	$0.7V_Z$ nom
BZV55C47	44.0	50.0	2	170	2	51.8	2	.050	$0.7V_Z$ nom
BZV55C51	48.0	54.0	2	180	2	57.2	2	.050	$0.7V_Z$ nom
BZV55C56	52.0	60.0	2	200	2	63.8	2	.050	$0.7V_Z$ nom
BZV55C62	58.0	66.0	2	215	2	71.6	2	.050	$0.7V_Z$ nom
BZV55C68	64.0	72.0	2	240	2	79.8	2	.050	$0.7V_Z$ nom
BZV55C75	70.0	79.0	2	255	2	88.6	2	.050	$0.7V_Z$ nom

*E24 Logarithmic Range (tolerance 5%)

Note: Also available in E24: 3% tolerance, reference BZV55F Series.
2% tolerance, reference BZV55B Series.
1% tolerance, reference BZV55A Series.

Electrical Specifications, 2.3W, SOD-87 Package

Type	ZENER Voltage V_Z at I_Z			Maximum Differential Resistance r_{diff} at I_Z		Maximum Temperature Coefficient S_Z at I_Z		Maximum Reverse Current I_R at V_R	
	V								
	Min	Max	mA	Ω	mA	%/°C	mA	μA	V
BZD27C7V5	7.0	7.9	100	2	100	0.07	100	50	3
BZD27C8V2	7.7	8.7	100	2	100	0.08	100	10	3
BZD27C9V1	8.5	9.6	50	4	50	0.08	50	5	5
BZD27C10	9.4	10.6	50	4	50	0.09	50	7	7.5
BZD27C11	10.4	11.6	50	7	50	0.10	50	3	8.2
BZD27C12	11.4	12.7	50	7	50	0.10	50	2	9.1
BZD27C13	12.4	14.1	50	10	50	0.10	50	2	10
BZD27C15	13.8	15.6	50	10	50	0.10	50	1	11
BZD27C16	15.3	17.1	25	15	25	0.11	25	1	12
BZD27C18	16.8	19.1	25	15	25	0.11	25	1	13
BZD27C20	18.8	21.2	25	15	25	0.11	25	1	15
BZD27C22	20.8	23.3	25	15	25	0.11	25	1	16
BZD27C24	22.8	25.6	25	15	25	0.11	25	1	18
BZD27C27	25.1	28.9	25	15	25	0.11	25	1	20
BZD27C30	28	32	25	15	25	0.11	25	1	22
BZD27C33	31	35	25	15	25	0.11	25	1	24
BZD27C36	34	38	10	40	10	0.11	10	1	27
BZD27C39	37	41	10	40	10	0.11	10	1	30
BZD27C43	40	46	10	45	10	0.12	10	1	33
BZD27C47	44	50	10	45	10	0.12	10	1	36
BZD27C51	48	54	10	60	10	0.12	10	1	39
BZD27C56	52	60	10	60	10	0.12	10	1	43
BZD27C62	58	66	10	80	10	0.13	10	1	47
BZD27C68	64	72	10	80	10	0.13	10	1	51
BZD27C75	70	79	10	100	10	0.13	10	1	56
BZD27C82	77	87	10	100	10	0.13	10	1	62
BZD27C91	85	96	5	200	5	0.13	5	1	68
BZD27C100	94	106	5	200	5	0.13	5	1	75
BZD27C110	104	116	5	250	5	0.13	5	1	82
BZD27C120	114	127	5	250	5	0.13	5	1	91
BZD27C130	124	141	5	300	5	0.13	5	1	100
BZD27C150	138	156	5	300	5	0.13	5	1	110
BZD27C160	153	171	5	350	5	0.13	5	1	120
BZD27C180	168	191	5	400	5	0.13	5	1	130
BZD27C200	188	212	5	500	5	0.13	5	1	150
BZD27C220	208	233	2	750	2	0.13	2	1	160
BZD27C240	228	256	2	850	2	0.13	2	1	180
BZD27C270	251	289	2	1000	2	0.13	2	1	200

Electrical Specifications, 350mW, SOT-23 Package, Pinout H

Type	ZENER Voltage* V_Z at I_Z			Maximum Differential Resistance r_{diff} at I_Z		Maximum Temperature Coefficient S_Z at I_Z		Maximum Reverse Current I_R at V_R		Pinout
	V									
	Min	Max	mA	Ω	mA	mV/°C	mA	μA	V	
BZX84C2V4	2.2	2.6	5	100	5	−3.5	5	50	1	H
BZX84C2V7	2.5	2.9	5	100	5	−3.5	5	20	1	H
BZX84C3V0	2.8	3.2	5	95	5	−3.5	5	10	1	H
BZX84C3V3	3.1	3.5	5	95	5	−3.5	5	5	1	H
BZX84C3V6	3.4	3.8	5	90	5	−3.5	5	5	1	H
BZX84C3V9	3.7	4.1	5	90	5	−3.5	5	3	1	H
BZX84C4V3	4.0	4.6	5	90	5	−3.5	5	3	1	H
BZX84C4V7	4.4	5.0	5	80	5	−3.5	5	3	2	H
BZX84C5V1	4.8	5.4	5	60	5	−2.7	5	2	2	H
BZX84C5V6	5.2	6.0	5	40	5	2.5	5	1	2	H
BZX84C6V2	5.8	6.6	5	10	5	3.7	5	3	4	H
BZX84C6V8	6.4	7.2	5	15	5	4.5	5	2	4	H
BZX84C7V5	7.0	7.9	5	15	5	5.3	5	1	5	H
BZX84C8V2	7.7	8.7	5	15	5	6.2	5	.700	5	H
BZX84C9V1	8.5	9.6	5	15	5	7.0	5	.500	6	H
BZX84C10	9.4	10.6	5	20	5	8.0	5	.200	7	H
BZX84C11	10.4	11.6	5	20	5	9.0	5	.100	8	H
BZX84C12	11.4	12.7	5	25	5	10.0	5	.100	8	H
BZX84C13	12.4	14.1	5	30	5	11.0	5	.100	8	H
BZX84C15	13.8	15.6	5	30	5	13.0	5	.050	0.7 V_Z nom	H
BZX84C16	15.3	17.1	5	40	5	14.0	5	.050	0.7 V_Z nom	H
BZX84C18	16.8	19.1	5	45	5	16.0	5	.050	0.7 V_Z nom	H
BZX84C20	18.8	21.2	5	55	5	18.0	5	.050	0.7 V_Z nom	H
BZX84C22	20.8	23.3	5	55	5	20.0	5	.050	0.7 V_Z nom	H
BZX84C24	22.8	25.6	5	70	5	22.0	5	.050	0.7 V_Z nom	H
BZX84C27	25.1	28.9	2	80	2	25.3	2	.050	0.7 V_Z nom	H
BZX84C30	28.0	32.0	2	80	2	29.4	2	.050	0.7 V_Z nom	H
BZX84C33	31.0	35.0	2	80	2	33.4	2	.050	0.7 V_Z nom	H
BZX84C36	34.0	38.0	2	90	2	37.4	2	.050	0.7 V_Z nom	H
BZX84C39	37.0	41.0	2	130	2	41.2	2	.050	0.7 V_Z nom	H
BZX84C43	40.0	46.0	2	150	2	46.6	2	.050	0.7 V_Z nom	H
BZX84C47	44.0	50.0	2	170	2	51.8	2	.050	0.7 V_Z nom	H
BZX84C51	48.0	54.0	2	180	2	57.2	2	.050	0.7 V_Z nom	H
BZX84C56	52.0	60.0	2	200	2	63.8	2	.050	0.7 V_Z nom	H
BZX84C62	58.0	66.0	2	215	2	71.6	2	.050	0.7 V_Z nom	H
BZX84C68	64.0	72.0	2	240	2	79.8	2	.050	0.7 V_Z nom	H
BZX84C75	70.0	79.0	2	255	2	88.6	2	.050	0.7 V_Z nom	H

*E24 Logarithmic Range (tolerance 5%)

(continued)

Note: Also available in E24: 3% tolerance, reference BZX84F Series.
2% tolerance, reference BZX84B Series.
1% tolerance, reference BZX84A Series.

Electrical Specifications, 350mW, SOT-23 Package (continued)

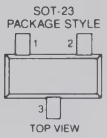
Type	V_Z (Nom)*		ZENER Impedance			Temperature Coefficient	I_R(Max)		Pinout
			Z_{zt} (Max)		Z_{zk}(Max) @ IZK = 0.25mA (Ω)				
	(V)	@ I_Z (mA)	Ω	@ i_{ZT} (mA)		θvz (Max) (%/°C)	(μA)	@ V_R (V)	
PMBZ5226B	3.3	20	28	20	1600	−0.070	25	1.0	H
PMBZ5227B	3.6	20	24	20	1700	−0.065	15	1.0	H
PMBZ5228B	3.9	20	23	20	1900	−0.060	10	1.0	H
PMBZ5229B	4.3	20	22	20	2000	±0.055	5.0	1.0	H
PMBZ5230B	4.7	20	19	20	1900	±0.030	5.0	2.0	H
PMBZ5231B	5.1	20	17	20	1600	±0.030	5.0	2.0	H
PMBZ5232B	5.6	20	11	20	1600	+0.038	5.0	3.0	H
PMBZ5233B	6.0	20	7	20	1600	+0.038	5.0	3.5	H
PMBZ5234B	6.2	20	7	20	1000	+0.045	5.0	4.0	H
PMBZ5235B	6.8	20	5	20	750	+0.050	3.0	5.0	H
PMBZ5236B	7.5	20	6	20	500	+0.058	3.0	6.0	H
PMBZ5237B	8.2	20	8	20	500	+0.062	3.0	6.5	H
PMBZ5238B	8.7	20	8	20	600	+0.065	3.0	6.5	H
PMBZ5239B	9.1	20	10	20	600	+0.068	3.0	7.0	H
PMBZ5240B	10	20	17	20	600	+0.075	3.0	8.0	H
PMBZ5241B	11	20	22	20	600	+0.076	2.0	8.4	H
PMBZ5242B	12	20	30	20	600	+0.077	1.0	9.1	H
PMBZ5243B	13	9.5	13	9.5	600	+0.079	0.5	9.9	H
PMBZ5244B	14	9.0	15	9.0	600	+0.082	0.1	10	H
PMBZ5245B	15	8.5	16	8.5	600	+0.082	0.1	11	H
PMBZ5246B	16	7.8	17	7.8	600	+0.083	0.1	12	H
PMBZ5247B	17	7.4	19	7.4	600	+0.084	0.1	13	H
PMBZ5248B	18	7.0	21	7.0	600	+0.085	0.1	14	H
PMBZ5249B	19	6.6	23	6.6	600	+0.086	0.1	14	H
PMBZ5250B	20	6.2	25	6.2	600	+0.086	0.1	15	H
PMBZ5251B	22	5.6	29	5.6	600	+0.087	0.1	17	H
PMBZ5252B	24	5.2	33	5.2	600	+0.088	0.1	18	H
PMBZ5253B	25	5.0	35	5.0	600	+0.089	0.1	19	H
PMBZ5254B	27	4.6	31	4.6	600	+0.090	0.1	21	H
PMBZ5255B	28	4.5	44	4.5	600	+0.091	0.1	21	H
PMBZ5256B	30	4.2	49	4.2	600	+0.091	0.1	23	H
PMBZ5257B	33	3.8	58	3.8	700	+0.092	0.1	25	H

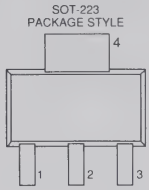
Electrical Specifications, 1.3W, SOT-223 Package, Pinout W

Type	V_Z(V) at I_{Ztest} = 5 mA Min.	Max.	Differential Resistance r_{diff} (Ω) at I_{Ztest} = 5 mA Typ.	Max.	Temperature Coefficient S_Z(mV/K) at I_{Ztest} = 5 mA Min.	Typ.	Max.	Diode Capacitance C_d(pF); f = 1 MHz V_R = 0 Typ.	Max.
BZV90C2V4	2.2	2.6	70	100	− 3.5	− 1.6	0	375	450
BZV90C2V7	2.5	2.9	75	100	− 3.5	− 2.0	0	350	450
BZV90C3V0	2.8	3.2	80	95	− 3.5	− 2.1	0	350	450
BZV90C3V3	3.1	3.5	85	95	− 3.5	− 2.4	0	325	450
BZV90C3V6	3.4	3.8	85	90	− 3.5	− 2.4	0	300	450
BZV90C3V9	3.7	4.1	85	90	− 3.5	− 2.5	0	300	450
BZV90C4V3	4.0	4.6	80	90	− 3.5	− 2.5	0	275	450
BZV90C4V7	4.4	5.0	50	80	− 3.5	− 1.4	0.2	130	180
BZV90C5V1	4.8	5.4	40	60	− 2.7	− 0.8	1.2	110	160
BZV90C5V6	5.2	6.0	15	40	− 2.0	1.2	2.5	95	140
BZV90C6V2	5.8	6.6	6	10	0.4	2.3	3.7	90	130
BZV90C6V8	6.4	7.2	6	15	1.2	3.0	4.5	85	110
BZV90C7V5	7.0	7.9	6	15	2.5	4.0	5.3	80	100
BZV90C8V2	7.7	8.7	6	15	3.2	4.6	6.2	75	95
BZV90C9V1	8.5	9.6	6	150	3.8	5.5	7.0	70	90
BZV90C10	9.4	10.6	8	20	4.5	6.4	8.0	70	90
BZV90C11	10.4	11.6	10	20	5.4	7.4	9.0	65	85
BZV90C12	11.4	12.7	10	25	6.0	8.4	10.0	65	85
BZV90C13	12.4	14.1	10	30	7.0	9.4	11.0	60	80
BZV90C15	13.8	15.6	10	30	9.2	11.4	13.0	55	75
BZV90C16	15.3	17.1	10	40	10.4	12.4	14.0	52	75
BZV90C18	16.8	19.1	10	45	12.4	14.4	16.0	47	70
BZV90C20	18.8	21.2	15	55	14.4	16.4	18.0	36	60
BZV90C22	20.8	23.3	20	55	16.4	18.4	20.0	34	60
BZV90C24	22.8	25.6	25	70	18.4	20.4	22.0	33	55
	at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA		at I_{Ztest} = 2 mA				
BZV90C27	25.1	28.9	25	80	21.4	23.4	25.3	30	50
BZV90C30	28.0	32.0	30	80	22.4	26.6	29.4	27	50
BZV90C33	31.0	35.0	35	80	27.4	29.7	33.4	25	45
BZV90C36	34.0	38.0	35	90	30.4	33.0	37.4	23	45
BZV90C39	37.0	41.0	40	130	33.4	36.4	41.2	21	45
BZV90C43	40.0	46.0	45	150	37.6	41.2	46.6	21	40
BZV90C47	44.0	50.0	50	170	42.0	46.1	51.8	19	40
BZV90C51	48.0	54.0	60	180	46.6	51.0	57.2	19	40
BZV90C56	52.0	60.0	70	200	52.2	57.0	63.8	18	40
BZV90C62	58.0	66.0	80	215	58.8	64.4	71.6	17	35
BZV90C68	64.0	72.0	90	240	65.6	71.7	79.8	17	35
BZV90C75	70.0	79.0	95	255	73.4	80.2	88.6	16.5	35

Pinout Diagrams

	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT H: SOT-23	N.C.	A	K	—
PINOUT W: SOT-223	A	K	A	K

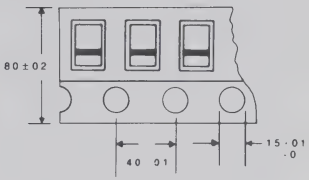




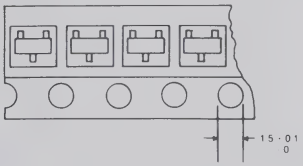
Marking Codes

Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BZD27 Series	*	BZX84C12	Y2	BZX84C68	Y20	PMBZ5242B	p8S
BZV55 Series	*	BZX84C13	Y3	BZX84C75	Y21	PMBZ5243B	p8T
BZV90 Series	*						
BZX84C2V4	Z11	BZX84C15	Y4	PMBZ5226B	p8A	PMBZ5244B	p8U
BZX84C2V7	Z12	BZX84C16	Y5	PMBZ5227B	p8B	PMBZ5245B	p8V
BZX84C3V0	Z13	BZX84C18	Y6	PMBZ5228B	p8C	PMBZ5246B	p8W
BZX84C3V3	Z14	BZX84C20	Y7	PMBZ5229B	p8D	PMBZ5247B	p8X
BZX84C3V6	Z15	BZX84C22	Y8	PMBZ5230B	p8E	PMBZ5248B	p8Y
BZX84C3V9	Z16	BZX84C24	Y9	PMBZ5231B	p8F	PMBZ5249B	p8Z
BZX84C4V3	Z17	BZX84C27	Y10	PMBZ5232B	p8G	PMBZ5250B	81A
BZX84C4V7	Z1	BZX84C30	Y11	PMBZ5233B	p8H	PMBZ5251B	81B
BZX84C5V1	Z2	BZX84C33	Y12	PMBZ5234B	p8J	PMBZ5252B	81C
BZX84C5V6	Z3	BZX84C36	Y13	PMBZ5235B	p8K	PMBZ5253B	81D
BZX84C6V2	Z4	BZX84C39	Y14	PMBZ5236B	p8L	PMBZ5254B	81E
BZX84C6V8	Z5	BZX84C43	Y15	PMBZ5237B	p8M	PMBZ5255B	81F
BZX84C7V5	Z6	BZX84C47	Y16	PMBZ5238B	p8N	PMBZ5256B	81G
BZX84C8V2	Z7	BZX84C51	Y17	PMBZ5239B	p8P	PMBZ5257B	81H
BZX84C9V1	Z8	BZX84C56	Y18	PMBZ5240B	p8Q		
BZX84C10	Z9	BZX84C62	Y19	PMBZ5241B	p8R		
BZX84C11	Y1						

*See individual device data sheet.



SOD-80C and SOD-87
Tape Dimensions
and Orientation
(Standard Diode Orientation is
Cathode Band at Sprocket Hole Side)

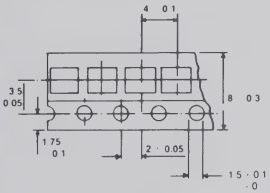


SOT-23
Orientation

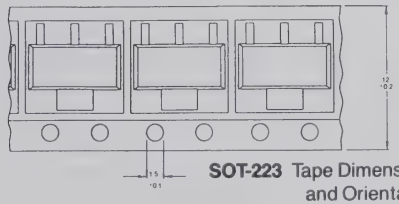
Tape and Reel Specifications

(Dimensions in mm)

SM Package	Devices per Reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13
SOD-80C	2.5K	7	8	TRL
	10K	13	8	TRL 13
SOD-87	2K	7	8	TRL



SOT-23
Tape Dimensions



SOT-223 Tape Dimensions
and Orientation

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NOTES

NOTES

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